Emergency department presentations in Tasmania, Australia: A sequential explanatory investigation.

by

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“Two roads diverged in a yellow wood, and I,
I took the one less travelled by,
and that has made all the difference.”
— Robert Frost, The road not taken

Dedication

> Imagine life as a game in which you are juggling some five balls in the air. You name them - work, family, health, friends and spirit - and you're keeping all of these in the air. You will soon understand that work is a rubber ball. If you drop it, it will bounce back. But the other four balls - family, health, friends and spirit - are made of glass. If you drop one of these, they will be irrevocably scuffed, marked, nicked, damaged or even shattered. They will never be the same. You must understand that and strive for balance in your life. (Dyson, 1991)

The above quote from a speech given by Bryan Dyson, the then CEO of Coca Cola at the 172nd commencement of the Georgia Tech Institute, was one I came across in the first weeks of commencing my PhD journey. Since then it has lived pinned above my computer monitor, superimposed onto a photograph of my amazing family; Geoff, Owen, Niamh and Alan. I wanted to make sure I never lost sight of what was really important.

This work is dedicated to all of you. Thank you for all your love, patience, understanding and hugs. To my boys, Owen and Alan, who are turning into impressive young men who I have no doubt will have much to contribute to society, I am so proud of you both. To Niamh, whose insight and wisdom at such a young age reminded me why I had started out on this journey in the first place and made me believe in myself when I was seriously considering walking away, I am excited to see what you decide to do with your life. Your options are endless.

Much is written about the sacrifices a PhD candidate makes whilst undertaking a course of doctoral study. However, my experience has taught me that the sacrifices the life partner of a doctoral student makes most definitely outweigh that of the candidate. It may not always have been obvious that I was aware of this, but I assure you I was and will be forever grateful. Early in 2015 I set myself two goals, to reach 2018-19 and (i) be happily married to a man who was happily married to me, and (ii) complete a PhD. Geoff, I think we did it. Thanks.

Declaration of Originality

This thesis contains no material which has been accepted for a degree or diploma by the University or any institution, except by way of background information and duly acknowledged in the thesis, and to the best of my knowledge and belief, no material previously published or written by another person except where due acknowledgement is made in the text of the thesis, nor does the thesis contain any material that infringes copyright.

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"If I have seen further, it is by
standing on ye shoulders of Giants"
— Sir Isaac Newton (1676)

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List of Abbreviations

ABO	Access Block Occupancy
ABS	Australian Bureau of Statistics
ACEM	Australian College of Emergency Medicine
ACS	Ambulatory Care Sensitive
ACSHs	Ambulatory Care Sensitive Hospitalisations
ACU	Acute Care Unit
AH	After Hours
AIHW	Australian Institute of Health and Welfare
AMA	Australian Medical Association
AMI	Acute Myocardial Infarction
AOR	Adjusted Odds Ratio
ARIA	Accessibility Remoteness Index of Australia
ATS	Australian Triage Scale
AUD	Australian Dollar
BP	Blood Pressure
CAP	Community Acquired Pneumonia
CCF	Congestive Cardiac Failure
CCL	Cardiac Catheterisation Laboratory
CI	Confidence Interval
COAG	Council of Australian Governments
COPD	Chronic Obstructive Pulmonary Disease
CT	Computerised Tomography
CVD	Cardiovascular Disease
DHHS	Department of Health and Human Services
DIT	Door-to-imaging Time
DMR	Digital Medical Records
DNW	Did Not Wait
DTA	Door-to-assessment Time
DTCT	Door-to-computerised-tomography Time
DTN	Door to Needle
ECG	Electrocardiograph
ED	Emergency Department
EDIT	Emergency Department Intervention Team
EDLOS	Emergency Department Length of Stay
EDWIN	Emergency Department Work Index
EJC	Emergency Journey Coordinator
ESI	Emergency Severity Index
FAAU	Flexible Acute Admissions Unit
FCA	Flexible Care Area
FCP	Full Capacity Protocol
FT	Fast-track

GP	General Practitioner
GPMP	General Practice Management Plan
GIH	Gastrointestinal Haemorrhage
HCH	Health Care Home
HCP	Health Care Professional
HF	Heart Failure
HR	Hazards Ratio
HSI Tas	Health Services Innovation Tasmania
ICD-10	International Classification of Diseases-Version 10
ICP	Independent Capacity Protocol
ICU	Intensive Care Unit
IM	Internal Medicine
IPA	Independent Practitioner Association
IPLOS	Inpatient Length of Stay
IQR	Interquartile Range
IVF	Intravenous Fluid
LAP	Low Acuity Presentation
LGH	Launceston General Hospital
LHN	Local Hospital Network
LOS	Length of Stay
LVEF	Left Ventricular Ejection Fraction
LWBS	Left Without Being Seen
MCH	Mersey Community Hospital
MI	Myocardial Infarction
MIU	Minor Injury Unit
MTE	Medical Team Evaluation
NEAT	National Emergency Access Target
NEDOCS	National Emergency Department Overcrowding Scale
NP	Nurse Practitioner
NSW	New South Wales
NWRH	North West Regional Hospital
NYHA	New York Heart Association
NZ	New Zealand
O/C	Overcrowded/ing
OECD	Organisation for Economic Cooperation and Development
OR	Odds Ratio
PBS	Pharmaceutical Benefits Scheme
PCI	Percutaneous Coronary Intervention
PHC	Primary Health Care
PHCAG	Primary Health Care Advisory Group
PHN	Primary Healthcare Network
PHT	Primary Health Tasmania
PIT	Physician in Triage

POCT	Point of Care Testing
PPH	Potentially Preventable Hospitalisation
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RAP	Rapid Assessment Policy
RACF	Residential Aged Care Facility
RACGP	Royal Australian College of General Practitioners
RCT	Randomised Control Trial
RHH	Royal Hobart Hospital
RN	Registered Nurse
SA2	Statistical Area-level 2
SEIFA	Socio-Economic Indexes for Areas
SES	Socio-economic Status
SIGN	Scottish Integrated Guidelines Network
SMS	Short-message-service
SOB	Short/ness of Breath
SPSS	Statistical Package for the Social Sciences
SSU	Short-stay Unit
STEMI	ST-Elevation Myocardial Infarction
TAT	Turnaround-time
THO	Tasmanian Health Organisation
THS	Tasmanian Health Service
TLP	Triage-Led Physician
UK	United Kingdom
USA	United States of America
UTI	Urinary Tract Infection
WA	Western Australia
WHO	World health Organisation
WIC	Walk-in Centre

Abstract

Introduction

The problem of increasing numbers of patients presenting to hospital emergency departments (EDs), contributing to crowding, has been labelled an international crisis. Consequences for patients who present to crowded EDs can include delays in receiving required medications, such as analgesics and antibiotics, and poorer patient outcomes, including increased inpatient mortality. Similarly, there are negative impacts for staff who work in crowded EDs, including an increased risk of experiencing violence in the workplace, increased workplace stress, and the reduced capacity to adhere to recommended treatment guidelines. In terms of the impact of ED crowding on the healthcare system itself, there is an identified correlation between ED length of stay and inpatient length of stay, albeit without a direct causative link being established.

Many strategies and policy initiatives have been suggested and implemented to combat ED crowding. These have focussed on ED demand management, timelier ED throughput times, and strategies to combat access block (i.e. the inability to transfer patients from the ED once immediate treatment is complete). Nevertheless, ED crowding continues to be one of the biggest issues facing healthcare systems worldwide.

Australia experienced a 37% increase in demand for ED services in the ten years from 2000-01 to 2009-10, with the greatest reported increase (73%) being in Tasmania. A 2014 report on the delivery of health services in Tasmania, commissioned by the Australian government, noted that there were high rates of ED access block and 'general practice-type' presentations in Tasmanian EDs, and suggested that this required urgent attention. The report highlighted that ED crowding was a key issue facing the state's healthcare system. Noting regional variations in ED growth across the state and recognising that ED presentations impacted significantly on the health care of Tasmanians, the Tasmanian government recommended that sources of ED presentations be analysed so that government decisions about the design and delivery of emergency care could ensure that patients continued to receive high quality care into the future. Recognising that ED crowding is an issue internationally, nationally and in Tasmania, the aim of this research project was to examine temporal and regional patterns

in hospital ED presentations in Tasmania, and subsequently investigate the factors driving ED usage.

Method

A systematic review of the international scientific literature investigating the causes, consequences and solutions to ED crowding was initially undertaken. The study subsequently utilised a multiphase, emergent mixed method, quantitative-dominant, explanatory sequential design. Phase one involved a retrospective data analysis of four years (2010-11 to 2013-14) of ED presentations across the state of Tasmania to identify longitudinal patterns of ED usage by the state's residents. Phase two involved a retrospective data analysis of six years (2010-11 to 2015-16) of inpatient data at one Tasmanian hospital to investigate the hypothesis that patient-perceived access to care, as measured by potentially preventable hospitalisations (PPHs), was one driver of ED presentations and subsequent hospitalisations in the elderly. Phase three involved an audit of the digital medical records (DMRs) of patients aged ≥ 75 years who had experienced a short-stay admission (length of stay ≤ 2 days) for congestive cardiac failure (CCF) in the years 2010-11 and 2015-16, at the same hospital, in an attempt to ascertain the reasons behind an increase in these specific types of admissions over the six-year period.

From the results from the first three quantitative phases, a profile was developed of the types of patients identified as contributing to increased ED presentations in the state (e.g. patients aged ≥ 75 years who had experienced a short-stay admission for CCF). In phase four, this profile was used to prospectively recruit participants and, using semi-structured interviews, qualitatively explore the role of patient-perceived access to care in ED presentations and subsequent PPHs in Tasmania.

Results

The systematic review illustrated that the negative consequences of ED crowding are well established, as well as highlighting a dearth in the academic literature of studies investigating the specific causes of crowding. Nationally and internationally, many solutions to crowding have been suggested, trialled and modelled, with varying levels of success. However, it was clear from the literature that the causes of ED crowding are not well understood and likely to

be contextually specific to the environment in which the crowding is taking place. Consequently, implemented solutions are unlikely to have a sustained impact if they are not addressing the specific causes of crowding in that environment. ED presentations by elderly patients with chronic and complex conditions emerged as a relatively new driver of crowding. Key results from each phase of the study were:

Phase 1: *Research question/s*

What are the longitudinal patterns of ED presentations in Tasmania?

Are there regional variations in patterns of ED presentations in Tasmania?

Wide-ranging regional variations in patterns of ED presentations were evident across the state's three regions, including a 16% increase in ED presentations in the South, versus a 3.9% decrease in the North-West over four years. There was a significant per capita increase in ED presentations in the South of the state by those aged ≥ 75 years, increasing at a mean rate of 12.5 per 1,000 residents per annum (95% CI 5.8 – 19.2).

Phase 2: *Research question*

What role do potentially avoidable admissions play in ED presentations in Tasmania?

The rates of PPHs increased by 21% over six years, compared with a 1.7% increase in non-PPHs; per capita PPHs by those aged ≥ 75 years increased by 10%. Short-stay admissions for PPHs accounted for 51% of all PPHs in patients aged ≥ 75 years and increased by 70% over six years. CCF was the most common associated condition, accounting for 21% of all short-stay PPHs in the elderly and had increased by 174% over six years.

Phase 3: *Research question*

What are the patient and/or system factors driving the increase in ED presentations and short-stay hospital admissions for elderly patients with congestive cardiac failure in Tasmania?

There was no appreciable difference over time in the profile of elderly patients who experienced an ED presentation and short-stay admission for CCF in the years 2010-11 and 2015-16; there was simply an increased volume of cases. The cohort in 2015-16 experienced 142 more ED presentations and 116 more hospital admissions compared to the cohort in

2010-11. A trend towards reducing length of stay even further (from 2 days to one day) was identified.

Phase 4: *Research question*

What role does patient-perceived access to care play in ED presentations and short-stay hospital admissions in Tasmania?

Interview participants presented as articulate individuals who were keen to be involved in the management of their chronic condition. When viewed through the lens of the domains of access to care, the data analysis identified issues relating to a lack of person-centred care, particularly in the acute care setting, as well as an apparent lack of patient education enabling self-management of their chronic conditions. Poor continuity of care in the primary care setting and inadequate levels of health literacy were also identified as contributing to ED usage and hospital admission.

Discussion

Following the findings of the systematic review that the causes of crowding were not well articulated, a study was designed to identify local contextual issues driving ED presentations in Tasmania. This study identified a link between patient-perceived access to care, increased ED presentations and subsequent hospitalisations by the elderly. Tasmania has a population with a higher mean age than all other states and territories in Australia. All of the state is classified as either regional or remote, over one-third of its population lives in regions classified as being within the most socioeconomically disadvantaged quartile, and a higher proportion of its population suffers from chronic illness when compared to Australia as a whole. All of these factors have been shown to potentially contribute to increased ED utilisation. Therefore, understanding the difficulties faced by elderly people with chronic conditions in this region, particularly as regards gaining access to services to prevent and manage exacerbations of their chronic conditions, may enable better planning for the future health care needs of this growing patient demographic, not only locally, but nationally and internationally.

Conclusion

There is limited research and therefore understanding of the specific factors driving the increase in demand for ED care. However, it is clear that with increasing presentations and constrained health budgets, healthcare systems worldwide are struggling with the burden of increased ED presentations. While the drivers of ED utilisation are likely to be multi-factorial and contextually specific, findings of this research suggest that patient-perceived access to care plays a role. This is particularly true of elderly patients with chronic conditions. Results from this thesis suggest that clinicians, researchers and policy makers should focus their efforts on improving the health literacy of the population to support patient self-management, as well as enhancing the availability of timely appointments with a regular primary care provider and providing genuine person-centred care.

Chapter 1. Introduction

“Begin at the beginning," the King said, very gravely,
"and go on till you come to the end: then stop.”
— Lewis Carroll, Alice in Wonderland

Sharon is a 31-year-old single mother of Molly (4) and Jack (2). It is 11pm on a Saturday night and Molly is crying and complaining of ‘tummy pain’. Molly has had the pain on-and-off for a couple of days. Sharon is concerned that it might be a ‘grumbling appendix’ and thinks she should take Molly to the local ED. Jack is asleep. Molly has been to the ED late at night once before when Jack fell out of bed and banged his head. She remembers sitting for hours in a busy waiting room with two tired and cranky children until they were eventually sent home with some written instructions and advice to return ‘if she is worried’. She doesn’t think she can face another night like that. Sharon is worried and doesn’t know what to do.

Brett is an experienced paramedic who began his Thursday night shift six hours ago, at 7pm. He has taken a number of patients to the ED tonight, and it is very busy. He has just been called out to an address he recognises. Maggie and George are an elderly couple. George has dementia and Maggie, his wife of 52 years, looks after him. George also has diabetes, emphysema, and cardiovascular disease. When Brett gets to the house Maggie is worried. George has become increasingly short of breath over several days. He has an appointment with his doctor tomorrow, but Maggie is worried that he needs to see a doctor sooner. Brett tries to reassure Maggie while he assesses George. George is confused and wants to stay at home. Brett eventually decides to put George in the ambulance and transports the couple to the ED. Brett doesn’t know if George will require admission, but he does know that George and Maggie are in for a very long night.

Scott is the triage nurse on the Sunday afternoon shift in the ED. When his shift commenced, four hours ago, the department was already full. Sixteen of the twenty-four cubicles contained patients who had already been assessed and

> admitted but were now waiting for a bed to become available in the hospital. The other cubicles were full of patients in various stages of assessment and there are now several people in the busy waiting room who Scott would prefer were in the main department. Scott is currently triaging Amanda, a 21-year-old nursing student. Amanda has been vomiting all afternoon. She thinks she may have eaten something 'funny' the night before. Scott triages Amanda as a category four, meaning it is safe for her to wait up to an hour before she is seen by a doctor. Scott knows that in reality she will wait much longer than that. Clinically, Scott knows that Amanda is well enough to sit in the waiting room, but his humanity tells him that vomiting in a public waiting room is very unpleasant for the patient. He reassesses the situation in the main department but there are no empty cubicles. As Scott sits Amanda in the waiting room, with 'vomit bowl' in hand, he does not feel he is doing a very good job.

The above three stories, although fictitious, are common occurrences across suburbs, cities and emergency departments (EDs) the world over. Year-on-year, the number of patients attending EDs for their health care needs increases, beyond that which can be explained by population growth alone. At the same time, health budgets are decreasing in relative terms, and inpatient bed numbers are falling. This 'crisis' has come to be known as 'ED crowding'. Literature about the issue is often crammed with facts, figures, and statistics to try to explain the phenomenon. In many ways, the majority of this thesis will be no exception. In my life as a mother and as a registered nurse, I have been 'Sharon' and 'Scott', I have cared for 'Amanda', 'George' and 'Maggie', and I have worked with 'Brett'. I wanted to include their stories here to bring a human face to the issue. As the debate relating to the causes and consequences of, and solutions to ED crowding continues, it is important to remember that behind every statistic there lies a human story. It is these human stories that make it imperative that researchers, policy makers, and clinicians focus their combined efforts into truly understanding the causes of this unsustainable change in acute health service usage, as well as developing effective, sustainable solutions to the problem.

1.1 Background

1.1.1 Emergency department crowding

The worldwide problem of ED crowding has been labelled an international crisis.[1] The Australasian College of Emergency Medicine (ACEM) defines ED crowding as,

> the situation where ED function is impeded primarily because the number of patients waiting to be seen, undergoing assessment and treatment, or waiting for departure exceeds either the physical bed and/or staffing capacity of the ED.[2(p.1)]

The international literature portrays ED crowding as having negative consequences for patients, staff, and the healthcare system itself. Reported negative consequences include delays in patients receiving required medications,[3, 4] an increased risk of staff experiencing violence in the workplace,[5] and an identified correlation between longer ED length of stay (EDLOS) and inpatient length of stay (IPLOS).[6] However, some of the reported findings are contradictory, including a more recent study that found no link between ED crowding and increased inpatient mortality.[7] Although it is likely that presenting to and/or working in a crowded ED may have undesirable consequences, it is important for policymakers and governments to have an accurate understanding of the effects of the issue, in order to make sound policy decisions regarding the effective allocation of resources.

In an effort to assist policymakers and researchers to understand the causes and thereby develop potential solutions, fifteen years ago an American group developed a conceptual model of crowding (Fig 1.1).[8] The model partitions ED crowding into three interdependent components: input, throughput and output.[8] Input relates to factors that increase demand for ED care, and is concerned with such issues as individuals' health-seeking behaviour and the availability of other forms of care.[8] Throughput relates to length of stay (LOS) in the ED and is concerned with the efficiency and effectiveness of ED processes.[8] The output arm of the model relates to the disposition of patients once their ED assessment and treatment has been completed.[8] Issues related to output are most commonly referred to as access block.

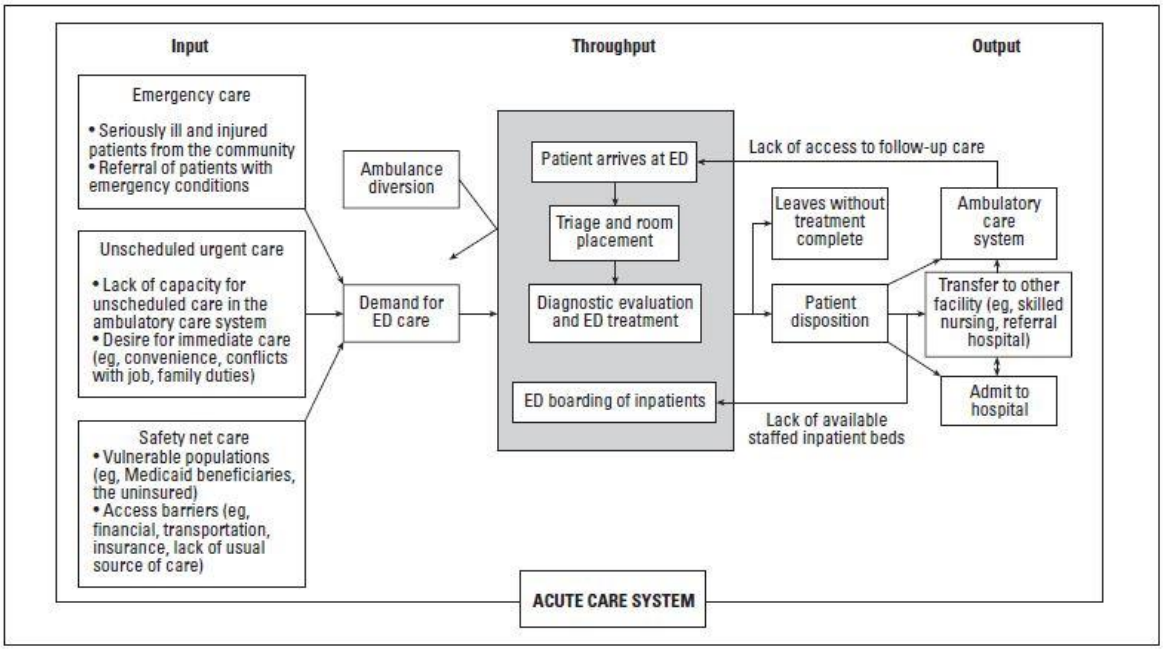

Figure 1.1 Asplin's conceptual model of ED crowding[8]

Over the past two decades many input,[9, 10] throughout,[11, 12] and output[13, 14] initiatives have been trialled to address crowding, with varying reported levels of success. In 2004, the UK government introduced nationally mandated, timed, patient disposition targets in an effort to reduced ED wait-times.[15] The target, called the 'four-hour rule', mandated that no patient would spend longer than four hours in the ED, from registration to disposition, regardless of whether they were ultimately admitted, transferred, or discharged.[15] The NZ government followed suit, and in 2009, introduced the 'Shorter Stays in Emergency Departments' target, mandating that all ED users leave the ED within six hours of arriving.[16, 17] The National Emergency Access Target (NEAT) was introduced in Australia in 2012, and, similar to the UK, stipulated that all ED patients spend no longer than four hours in the department.[18, 19] Different jurisdictions undertook different approaches to meeting the targets, with varying reported levels of success.[11, 19]

The challenges of increased ED demand, and the pressure that this places on an already overburdened system is well recognised. A 2018 UK Care Quality Commission report that investigated ways to safely manage increased ED demand presented a number of potential strategies to reduce ED attendances.[20] Suggested strategies included: extending access to community services during the week and at weekends, care plans for adults with social care

needs and at risk of an hospital admission, GP referrals for hospital care to go straight to an appropriate assessment unit and thereby bypass the ED, and the establishment of fragility clinics for the elderly so they too can bypass the ED.[20] Similarly, Australia has recognised the need to consider demand management initiatives to try to contain the growth in ED presentations. These have included: a revised version of an afterhours general practice funding scheme that provides improved funding incentives to general practitioners to provide better out-of-hours care,[21] and the recent commencement of a nationwide trial of Health Care Homes (HCH), that aims to provide better coordinated care for elderly patients with complex and chronic conditions, and thereby reduce their need for ED attendances.[22]

In response to a large number of planned representations to the ED in the North of the state, in 2014 the Tasmanian Healthcare Service (THS) introduced a Community Nursing Enhanced Connection Service.[23] The service is exclusively for patients who attend the ED and require follow-up care and treatment (e.g. plaster checks, dressing changes) and has shown some success at reducing ED return visits by this patient group.[23] Also, in 2016 the THS introduced a Community Rapid Response Service in the North of the state, giving local GPs the opportunity to refer patients who would otherwise have been sent to the ED to a team of healthcare professionals who could safely manage the patient at home.[24] This initiative was so successful at reducing ED presentations by this patient population that it has now been rolled out across the state.[25]

Nevertheless, despite many trialled and suggested demand management strategies and policy initiatives, ED crowding continues to be one of the biggest issues facing healthcare systems worldwide.[26] In the eight years 2007-08 to 2016-17, England experienced a 22% increase in attendances at its hospital accident and emergency departments, equating to an annual average increase of 2.3%, with an annual population growth of 0.8% over the same time period.[27] Similar increases in ED presentations, contributing to crowding, have been documented in Canada,[28] the USA,[29] Asia,[30] and Europe.[31] Australia is no exception, and experienced a 37% increase in demand for ED services in the ten years from 2000-01 to 2009-10.[32] There were 7.8 million presentations to Australian public hospital EDs in 2016-17, or 21,000 per day.[33] In the same year, 21% of all presentations were by those aged ≥ 65 years, who represented 15% of the population.[33]

Locally, Tasmania experienced a 73% increase in demand for ED services in the ten years 2000-01 to 2009-10, the largest reported increase in the country.[32] A 2014 report on the delivery of health services in Tasmania, commissioned by the Australian government noted '*high rates of access block and GP-type presentations in emergency departments* [that] *require urgent attention*'.[34(p.xii)] This report highlighted that ED crowding was a key issue facing the Tasmanian healthcare system. Noting the regional variations in ED growth across the state, and recognising that ED presentations impact significantly on the health care of Tasmanians, the Tasmanian government recommended that sources of ED presentations be analysed so that government decisions about design and delivery of emergency care could ensure that patients continued to receive high quality care into the future.[35]

In order to deliver better quality health care and improve outcomes for patients, the University of Tasmania was allocated $12 million by the Federal Government to help implement clinical redesign in the Tasmanian hospital system between 2013-2016.[36, 37] The group, Health Services Innovation Tasmania (HSI Tas.), worked collaboratively with the Tasmanian Health Service (THS), the Department of Health and Human Services (DHHS), Primary Health Tasmania (PHT), the Commonwealth Department of Health and the office of the State Minister for Health to manage a state-wide program of clinical redesign.[36] Five key priority areas were endorsed by the consortium governing the program of work, with improving emergency access being one.[36] At the time of commencing this course of doctoral research (2015), clinical redesign within the THS had already begun to improve patient flow, both within the states EDs (throughput),[38] and in hospital inpatient wards (output).[36] Therefore, it was decided that the focus of this research would be on the drivers of ED utilisation (input). It was envisaged that if we could address the issues of ED crowding from the three positions of input, throughput, and output, simultaneously, we could go some way towards understanding high rates of crowding in Tasmanian EDs.[34]

1.1.2 The Australian healthcare system

In order to understand the complexities of addressing health care issues in Australia, it is important to have an understanding of how the system is structured. Consequently, the next section will give a brief overview of the structure and funding of the Australian healthcare system.

The structure of the Australian healthcare system has its roots in its federal system of government.[33] The federal government oversees six State and two Territory governments. Within each state and territory there are also local governments (e.g. shires or councils). The health system is funded by all levels of government, non-government organisations, private insurers, and individuals through co-payments.[33]

Australian citizens are entitled to free care in public hospitals, including emergency services, based on clinical need.[39] In 2015-16, there were 701 public hospitals in Australia, with 61,000 beds.[33] There were also 630 private hospitals with 33,100 beds.[33] Both the public and private sectors provide inpatient, outpatient and emergency care. Rates of hospital admissions are increasing, with reported rates of hospital separations increasing by 3.5% per annum over the four years 2011-12 to 2015-16.[40] Separations for private hospitals increased at a slightly greater rate (3.7%) than that of public hospitals (3.3%).[40] [i]Local Hospital Networks (LHN) are state and territory authorities set up to manage public hospital services and funding.[33] All public hospitals are part of an LHN, with 136 networks currently operating across Australia.[33]

In Australia, primary care is accessed through medical doctors, known as general practitioners (GPs), who assess and treat patients in the community. GPs can also refer patients to specialists or to hospitals, and, in effect, act as 'gatekeepers' to the acute care system. Thirty-one Primary Healthcare Networks (PHNs) operate across the country, and work with GPs and other primary care providers to create efficiencies in the system, and to help coordination care between different service providers.[33] As regards administration of health services, the system is complex, with multiple layers of administration, service delivery and financing (Fig. 1.2).[41]

[i] LHN is the term used nationally; terms used in states and territories for these networks vary

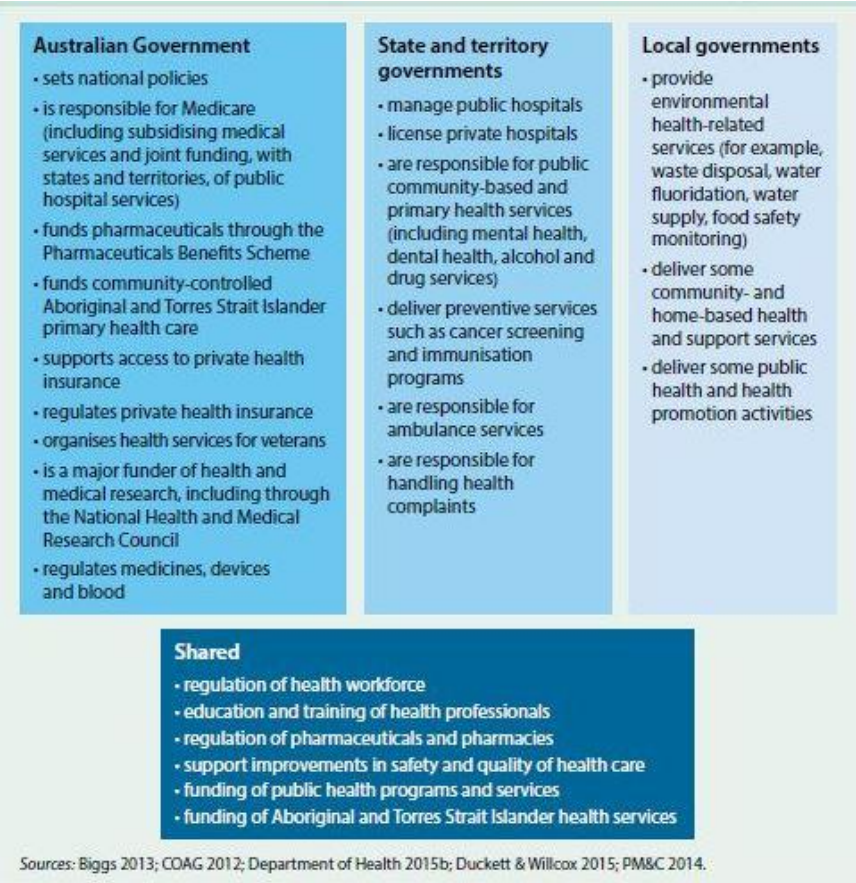

Figure 1.2 Main roles of government in the Australian healthcare system[41]

The publicly funded primary healthcare system is called Medicare.[42] Medicare was introduced in 1984 and is a compulsory, universal health insurance scheme which is funded through taxation.[42] The Medicare Levy is a form of progressive taxation whereby lower income earners pay 1.5% of their gross taxable income, increasing to 2.5% for individuals and families who do not have private health insurance and earn over a certain amount. A system of 'co-payments' is in operation, whereby the federal government reimburses 85% of a scheduled or recommended fee.[41] If a provider chooses to charge above the schedule fee, the patient pays the difference, or co-payment. 'Bulk-billing' occurs when the provider charges only the schedule fee and therefore the service is free to the user. The proportion of GP attendances bulk-billed varies across the country, ranging from 89% in the Northern Territory to 62% in the Australian Capital Territory (2017).[33]

In terms of total spending on health care, Australia ranks in the middle third of the 30 member countries of the Organisation for Economic Cooperation and Development

(OECD) (2018).[33] Over a decade (2006-07 to 2015-16) national spending on health grew by 50%, compared with a population growth of 17%.[33] In 2015-16 the total health budget was $170 billion, or 10% of gross domestic product, which was marginally above the OECD average.[33] Together, public hospitals (39%) and primary health care (35%) accounted for three-quarters of all health spending (Fig. 1.3).[43] Whereas the largest proportion of spending on health care in 2015-16 was in the hospital sector,[43] the largest increase in spending between 2010-11 to 2015-16 was in primary care, increasing by 20% over the five-year period.[44]

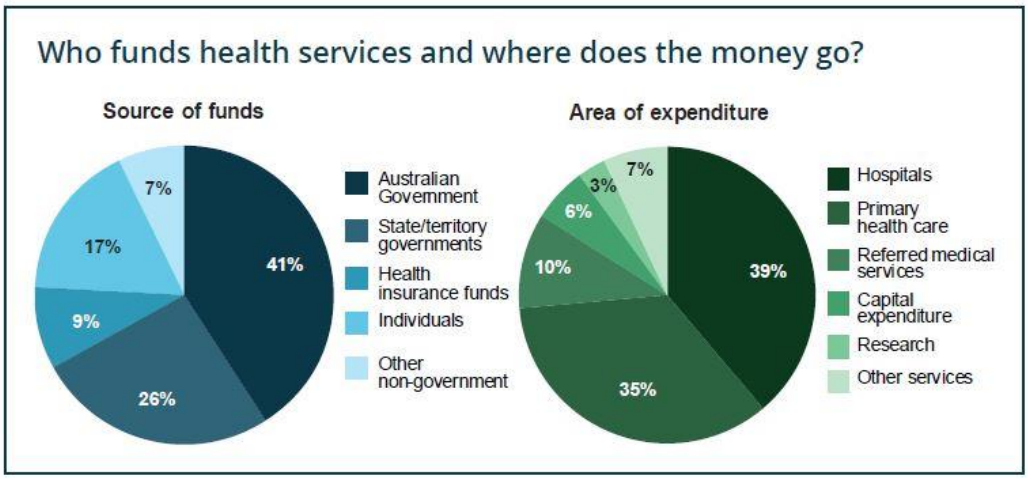

Figure 1.3 Who funds health services in Australia and where the money is spent[33]

Different levels of government fund different sectors of the system. The federal government funds a Pharmaceutical Benefits Scheme (PBS), ensuring affordable medicines, when they are prescribed by a GP or other health practitioner with prescribing rights.[42] The federal government is responsible for leading the development of national health policy, administering Medicare (through funding GPs), funding medicines (through the PBS), regulating health care practitioners, providing funds to the state and territory governments to assist in public hospital provision, overseeing PHNs, regulating and subsidising private health insurance and funding health and medical research (Fig. 1.2).[33] The state and territory governments are responsible for financing and managing public hospitals, regulating and licencing private hospitals, delivering public community-based primary health services, providing preventative services and

providing ambulance services (Fig. 1.2).[33] Local governments, in some jurisdictions, are responsible for environmental health-related services, such as waste disposal, providing community and home-based support services and funding health programs (Fig. 1.2).[33]

As demonstrated above, the complex structure of the health system is reflected in its funding model. Funding a part of the system is not necessarily correlated with having responsibility for its management or operation (e.g. the federal government partially funds public hospitals, which are managed by the state and territory governments).[33] The Australian healthcare system has been the focus of constant reform, focussing on two main issues: the relationships and responsibilities of the different levels of government, and the relationship between the private and public systems.[41] This has led to disagreements between state and federal governments related to 'cost-shifting', which is seen as an undesirable outcome of the very fragmented system.[41] All Australian health ministers are a member of the Council of Australian Governments (COAG) Health Council.[33] With improvements in health and subsequently increasing life expectancy, increased demand for health services and coordinated management of chronic conditions have been recognised as current and future challenges for the system.[33] Through COAG, the federal, state, and territory governments have taken a national approach to the coordination of care under the 2011 National Health Reform Agreement.[45] The objective of the agreement was to ensure the Commonwealth, state and territory governments worked in partnership to improve health outcomes for all Australians.[45] The Commonwealth agreed that it would take a lead role in funding and delivering primary health care, and work in partnership with the states and territories, with the overall aim of enabling patients to *receive the care they need when and where they need it – and in doing so, taking pressure off public hospitals.*[45(p. 6)]

1.1.3 The Tasmanian context

Tasmania is Australia's most southerly and only island state, with a population of 520,877 (2017).[46] Tasmania has the highest decentralised population of all of Australia's states and territories, with almost 60% of its population living outside of the state capital (Hobart).[47] The whole of the state is classified as either regional, rural or remote (no major cities).[48] The state has the highest mean age of all Australian states and territories

(42 years), and experienced the greatest increase in median age in the past 20 years (increase of 7 years from 1997 to 2017).[46] The mean age is increasing due to low fertility rates, increasing life expectancy and the emigration of younger adults from Tasmania to the Australian mainland.[47] Tasmania has the slowest annual population growth rate in Australia (0.2% in 2012-13).[47] Average disposable income in the state is 15% below the national average (2015), and almost 33% of the population lives in regions classified socioeconomically in the most disadvantaged quartile.[47] Tasmania's population has the lowest proportion of people with undergraduate university degrees and the lowest proportion of people with post-graduate qualifications of all states and territories.[47]

In terms of health indicators, although the burden of chronic disease is generally the same in Tasmania as for the rest of Australia (with the exception of chronic obstructive pulmonary disease (COPD), which is greater in Tasmania), Tasmania's age-standardised mortality rate for all of the top ten causes of death are higher than the national figure.[47] For example, in 2012, the death rates for cancer and ischaemic heart disease were 10.6% and 20.7%, respectively, above the national average.[47] The number of public hospital separations in Tasmania, between 2011-12 and 2015-16 increased at a rate greater than the national average (5.3% versus 3.5%).[40] However, for conditions where hospital admission is deemed potentially avoidable if timely and adequate non-hospital care is provided (Potentially Preventable Hospitalisations (PPHs)), Tasmania ranked second lowest of all states and territories (2015-16).[40] Although there is some regional variation, bulk-billing rates for GP consultations in Tasmania are 5.5% below the national average,[47] meaning Tasmanians are more likely to incur an out-of-pocket cost for GP care than are residents of other Australian states.

Similar to the rest of the Australian healthcare system, the Tasmanian system has seen much reform and restructure. Between July 2012 and July 2015, Tasmania's acute healthcare system operated as three separate Tasmanian healthcare organisations (THOs): (THO-North, THO-NW and THO-South). With the aim of driving efficiencies, and to enable a state-wide approach to the delivery of health services, in July 2015 the system was united to form one Tasmanian Health Service (THS).[49] Governance and strategic oversight of the new THS was provided by a Governing Council.[50] From July 2018, a system of more localised governance was established to oversee day-to-day

operations, although the system still operates as one THS. There are four major public hospitals in the THS: Launceston General Hospital (LGH) in the North, the Mersey Community Hospital (MCH) and the North-West Regional Hospital (NWRH) in the North-west, and the Royal Hobart Hospital (RHH) in the South, which is also the state's tertiary referral centre. Each of these four hospitals operates a 24-hour ED. The South of the state also has two private, 24-hour EDs.

As the above has shown, Tasmania is an island state which has a population that is older, more geographically dispersed, and more socioeconomically disadvantaged, and has higher aged-standardised mortality rates for chronic conditions, than the rest of Australia. Government reports consistently show that older people, people from lower socioeconomic areas, people with one or more chronic condition and people who reside in areas designated as being regional or remote are all more likely to attend an ED.[51, 52] ED crowding is recognised as a major issue in Tasmania, with the state government calling for research to be undertaken investigating the sources of ED presentations across the state.

Therefore, the aim of this study was to examine temporal and regional patterns in hospital ED presentations in Tasmania, and subsequently, investigate the factors driving ED usage.

1.2 Purpose statement

This purpose of this mixed methods study was to examine temporal and regional patterns in hospital ED presentations in Tasmania, and subsequently, investigate the factors driving ED usage. Following on from an extensive systematic review, this research was conducted over four phases, undertaken sequentially, with each phase addressing new research questions identified in the preceding phases.

Phase one involved a retrospective data analysis of state-wide ED presentations over four years, with the aim of identifying longitudinal patterns of ED presentations across the state.

Phase two involved a retrospective data analysis of six years of inpatient data from one hospital in the South of the state, with the aim of investigating the hypothesis that

patient-perceived access to care, as measured by PPHs, is a driver of ED presentations and subsequent hospitalisations by the elderly.

Phase three involved a digital medical records (DMR) audit of a subset of patients identified in phase two as having increased ED presentations and admissions, with the aim of identifying the patient and/or system level factors driving the increase in ED presentations and short-stay hospital admissions by elderly patients with Congestive Cardiac Failure (CCF).

Phase four. Incorporating the findings from phases 1-3, a profile was built of the types of patients identified as contributing to increased ED demand in the state. This profile was then used to prospectively recruit a sample of participants to undertake semi-structured interviews, to explore the role of patient-perceived access to care in ED presentations and subsequent PPHs in Tasmania.

The rationale for using a multiphase design was to allow for the direction of the project to emerge, depending on the findings from each specific phase. The reason for choosing a mixed methods approach was to use the qualitative findings to help explain the results of the initial three quantitative phases.

1.3 Study aim and questions

1.3.1 Study aim

The aim of this study was to examine temporal and regional patterns in hospital ED presentations in Tasmania, and subsequently investigate the factors driving ED usage.

1.3.2 Research questions

Using a multiphase, emergent, mixed methods approach, this study addressed the following research questions:

1. What evidence exists in the peer-reviewed literature as to the causes and consequences of, and solutions to, ED crowding?
2. What are the longitudinal patterns of ED presentations in Tasmania?
3. Are there regional variations in patterns of ED presentations in Tasmania?

4. What role do potentially avoidable admissions play in ED presentations in Tasmania?
5. What are the patient and/or system level factors driving the increase in ED presentations and short-stay hospital admissions for elderly patients with CCF in Tasmania?
6. What role does patient-perceived access to care play in ED presentations and short-stay hospital admissions by the elderly in Tasmania?

1.4 Thesis structure

***Chapter two, Methodology*:** This research used a multiphase, emergent mixed methods, quantitative-dominant, explanatory sequential design. Chapter two presents an overview of the growth of mixed methods research as a distinct research paradigm, the pragmatic assumptions associated with mixed methods research, and the development of mixed methods typologies and designs, as well as a rationale for the choice of research design in this study.

***Chapter three, Emergency department crowding: a systematic review of causes, consequences and solutions*:** Chapter three contains the final Word document of a systematic review titled 'Emergency department crowding: a systematic review of causes, consequences and solutions', published in *PLOS ONE* in August 2018. A key finding of this review was a dearth in the published research investigating the causes of ED crowding. Due to the different formatting styles of many academic journals, it was decided to include the final Microsoft Word version of all published papers to ensure consistent formatting throughout this thesis.

***Chapter four, Characteristics of longitudinal patterns of emergency department presentations in Tasmania*:** Chapter four contains the final Word document of a published manuscript titled 'Planning for the future: emergency department presentation patterns in Tasmania, Australia', published online in *International Emergency Nursing* in September 2017. This paper describes the findings of a detailed analysis of four-years of ED presentations in Tasmania, the smallest of Australia's six

states. A key finding of the analysis was a significant per capita increase in ED presentations in the South of the state by those aged ≥ 75 years.

Chapter five, Access to healthcare and how it is measured: As patient-perceived access to care has been proposed as a potential driver of ED presentations by the elderly, Chapter five presents an overview of the literature into access to healthcare. A group of conditions called PPHs have been identified as an acceptable measure of patient-perceived access to care. Therefore, the second half of Chapter five details the processes involved in identifying the conditions considered to be potentially preventable, the development of the term PPHs, and the research evidence to support PPHs as an indicator of patient-perceived access to care.

Chapter six, Emergency department crowding in Tasmanian: the role of potentially avoidable admissions: Chapter six contains the final Word document of a peer-reviewed manuscript accepted for an oral presentation at the 6th Annual International Conference on Worldwide Nursing, in Singapore in July 2018 titled 'Patient-perceived access to care is a driver of increased emergency department presentations by the elderly'. This paper describes the findings of a retrospective data analysis of six-years of hospital admissions to one Australian hospital, specifically looking at PPHs. Key findings of the analysis were a 10% per capita increase in PPHs, and a 174% increase in short-stay hospitalisations for CCF, over the six years, by patients aged ≥ 75 years.

Chapter seven, Factors driving the increase in emergency department presentations and short-stay hospital admissions for elderly patients with congestive cardiac failure: Chapter seven provides the methods and results of a DMR audit to compare the experiences of the 175 individuals aged ≥ 75 years who experienced a short-stay hospital admission for CCF at the RHH in the years 2010-11 and 2015-16. A key finding of the audit was that, although the profile of these patients had not changed appreciably over the six years, there were 142 more ED presentations and 116 more hospital admissions by patients in this demographic in 2015-16 than in 2010-11, placing a significant burden on health system resources.

Chapter eight, The role of patient-perceived access to care in emergency department presentations and short-stay hospital admissions: Chapter eight details the methods and results of phase four of the research project, which involved undertaking semi-structured interviews to qualitatively explore the role of patient-perceived access to care in ED presentations in Tasmania. A key finding of the analysis was that, although the participants perceived that they had good access to care when they required it, when viewed through the lens of the domains of access to care, their actual access was less than ideal. The main areas of concern included a lack of person-centred care, poor continuity of care with a preferred GP and inadequate levels of health literacy, leading to a limited ability of the participants to be involved in self-management of their chronic condition.

Chapter nine, Discussion: Chapter nine provides a discussion of the study findings, with reference to the study aims and in the context of the broader literature in the field of ED crowding and its relationship to patient-perceived access to care. Limitations of the study are discussed and recommendations for clinicians, policy makers and future research provided.

1.5 Significance and contribution of the research

This research project provides results and recommendations for policy makers, health service managers and researchers exploring the future of health care services, both within Tasmania, as well as nationally and internationally. The findings from the systematic review highlighted that, although many solutions to the problem of ED crowding have been trialled and modelled, there is a scarcity of studies identifying the specific causes of crowding. Results of the review indicated that causes are likely to be contextually specific to the environment in which the crowding is taking place. The contextual specificity of the drivers of ED demand were also highlighted in phase one of this project. The state-wide ED analysis identified wide-ranging regional variations in patterns of ED use across the state. This is an indication that, even within a geographically small and sparsely populated state, such as Tasmania, the drivers of ED utilisation are not consistent across the regions. Therefore, it would be prudent for

clinicians, researchers and policymakers to undertake an analysis of the drivers of crowding in their local environment, before initiating costly solutions.

This research found that older people with chronic conditions are one of the drivers of increased ED demand in this region. Phase two of this project identified a link between increased ED presentations, and subsequent hospitalisations, by the elderly, and patient-perceived access to care. Although identified increases in ED presentations by the elderly are generally thought to be because older people are sicker, with more comorbidities, and tend to bypass their GP more often to attend the ED, phase three of this project found this not to be the case for the elderly in this region. Findings of this research suggest that focusing on patient-perceived access to care, with a particular emphasis on improving health literacy to support patient self-management, as well as enhancing the availability of timely appointments with a regular primary care provider and thereby providing person-centred care, could go some way towards reducing ED presentations by the elderly (and thereby potentially have a positive impact on ED crowding).

Chapter 2. Methodology

"Though this be madness, yet there is method in't."
— William Shakespeare, Hamlet

2.1 Introduction

This thesis set out to examine temporal and regional patterns in hospital ED presentations in Tasmania, and subsequently investigate the factors driving ED presentations. Early engagement with the literature indicated that there had been a significant volume of published research on the ED crowding phenomenon. Specifically, the research centred around consequences and/or causes, as well as solutions to ED crowding. Undertaking a systematic review of the published literature has been identified as an 'invaluable' scientific activity, as it distils existing research findings and provides data for rational decision making.[53] Therefore, it was decided that this research project would begin by undertaking a systematic review of the published literature into the causes and/or consequences of, as well as the solutions to, ED crowding.

Subsequently, a multiphase sequential, explanatory research design that incorporated emergent mixed methods (quantitative-dominant) was employed. Each new phase built upon what was learnt in the preceding phases and addressed new questions that emerged during the earlier phases.[54] Initially, quantitative data analyses were undertaken in three phases to; (i) identify trends in Tasmanian ED presentations by region, demography and acuity, (ii) investigate the hypothesis that patient-perceived access to care was one of the factors driving the increase in ED presentations in a significant cohort identified in phase one, and (iii) identify changes over time that could highlight factors contributing to the increase in ED presentations by this cohort of patients. Using the results from the three distinct quantitative phases of the project, a profile was built of the types of patients presenting to the ED in increasing numbers. Phase four of the project used this profile to prospectively recruit a sample of patients

to undertake semi-structured interviews to better understand how and why they attended the ED, including the role of perceived access to care.

This chapter presents an overview of the emergence of mixed methods research as one of three distinct research paradigms (quantitative, qualitative and mixed methods), the pragmatic assumptions associated with mixed methods research, and the development of mixed methods typologies and designs, as well as a rationale for the use of a multiphase emergent mixed methods approach as the research methodology in this study. A visual model of the research design procedures will also be provided.

2.2 Mixed methods research

The early discussions around the combining of both quantitative and qualitative data within one research project has been attributed to Campbell and Fiske in 1959.[55] The pair introduced the idea of triangulation, referring to 'multi-operationalism', where more than one method is used to ensure that any explained variance is a result of the trait under study, and not a result of the method.[56] Through the 1980s and 1990s, a number of different disciplines began to publish mixed methods studies, including sociology, management, nursing, medicine and education,[57] leading to the design becoming accepted as the third research paradigm.[58] Mixed methods researchers believe mixed method designs offer a broader understanding of the phenomena under study, when compared to stand-alone quantitative or qualitative designs, making the resultant sum of the whole greater than its parts. Consequently, it has been stated that mixed methods research provides *'more robust opportunities for devising policies and practices to implement positive change'*,[59(p.816)] which has led to some funding bodies preferring,[57, 59] and even demanding [60] mixed methods research designs.

In mixed methods research designs the different methods bring together different perspectives, making its employment useful in unravelling complex phenomena.[61] Mixed methods research designs have become increasingly popular in health services research, due to the often complex and multifaceted nature of research questions in this field.[62] In an editorial discussing the false dichotomy of quantitative versus qualitative research, Walsh (2012) warned against researchers and academics becoming so entrenched in any one position that they become blinded to the possibility of other

research methods.[63] He advocated for more academic debate around different research methodologies, including the ontological and epistemological underpinnings of various research approaches.[63] He further stated that

> Research is about knowing, understanding and exploring the world in which we find ourselves. There is no privileged way of doing this. The approaches we currently possess are but windows that frame our view of the world but also limit what we can see. We should not think that our window is the only one, or indeed, our view the best.[63(p.10)]

2.2.1 Definition

With the aim of developing a definition of mixed methods research, in 2007 Johnson et al.,[56] contacted the 36 leading mixed methods research methodologists at that time and asked them to provide their definitions. Nineteen different statements were provided, some by pairs of researchers. A constant comparison analysis method was used to code and theme the statements. After the completion of this exercise, Johnson and colleagues put forward the following definition:

> Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g. use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breath and depth of understanding and corroboration.[56(p.123)]

The above definition of mixed methods will be the working definition used for this thesis.

2.2.2 The paradigm debate

Throughout the 1970s and 1980s, the debate about mixed methods research focussed largely on the different philosophical assumptions or world views associated with different types of research (quantitative and qualitative) and therefore the inherent difficulties in mixing the two.[57, 60] This period in the development of mixed methods became known as *the paradigm wars,* with both quantitative and qualitative purists advocating the *incompatibility thesis* as proposed by Howe (1988),[64] that is, the two types of research could and should not be mixed. The post-positive world view of the

quantitative researcher is based on the assumption of a singular reality where the researcher objectively collects data from a distance, uses checks to ensure the elimination of bias and uses a formal style and deductive approach to understand phenomena.[57, 58, 65] This approach is considered by some to be incompatible with the constructivist world view of the qualitative researcher, which is based on the existence of multiple realities where the researcher visits with participants to undertake data collection, openly discusses their personal biases, and uses an informal style and inductive approach.[57, 58, 65]

Many mixed methods researchers disagree with the above argument. It has been suggested that, if methods are considered as techniques, than methods are not tied to particular philosophical assumptions,[66, 67] and so can be fused *'transcending the paradigm wars'.*[60(p.334)] In an argument against the use of the 'q' words (quantitative and qualitative) in research, Gorard (2010) stated that the most serious mistake made in research development was *'the suggestion that methods imply values and are a matter of personal preference, rather than a consequence of the problems to be overcome via research'.*[68(p.248)] Others have argued that *'the practical demands of the problem are primary; inquirer flexibility and adaptiveness are needed to determine what will work best for a given problem'*.[69(p. 257)] Tashakkori and Teddie called for the abandonment of the *'forced-choice'* between post-positivism and constructivism, and suggested that the research question should be of primary importance, more important than either the method or the philosophical world view that underlies the method.[70]

A third world view, pragmatism, has been suggested as a useful paradigm for undertaking mixed methods research,[56, 58, 71, 72] although not all methodological specialists agree with this view,[66, 73] with concerns that it is attractive to mixed methods researchers more for its practicality, rather than on any philosophical basis.[74] Pragmatism accepts that there are both singular and multiple realities, uses a practical approach to data collection, presents both biased and unbiased interpretations, and may employ formal or informal approaches to combining quantitative and qualitative data.[58, 65] Pragmatism is orientated around 'what works' and real-world practice.[57] Creswell and Plano Clark provided a rationale for the adoption of pragmatism as the best world view for mixed methods research:

> Pragmatism is typically associated with mixed methods research as an overarching philosophy embraced by a large number of mixed methods scholars. The focus is on the consequences of the research, on the primary importance of the question asked rather than the methods, and on the use of multiple methods of data collection to inform the problem under study.[57(p.37)]

In his defence of pragmatism as adding new options for addressing methodological issues in social science research, Morgan contended that pragmatism transcends the divide between the two most traditional methodological stances, quantitative and qualitative.[75] He argued that in real world research, the process of moving between theory (inductive) and data (deductive) is never wholly unidirectional, and therefore abductive reasoning, where observations are converted into theories, with these theories assessed through action, is a more appropriate approach (Table 2.1).[75] He similarly claimed that 'complete objectivity' and 'complete subjectivity' are impossible to achieve and asserted that inter-subjectivity, with the researcher working back and forth between various frames of reference, is a more realistic description of what actually happens in real world research. Finally, he contended that the pragmatic approach to research transcends the distinction between context-specific or generalizable results.[75] He stated *'I do not believe it is possible for research results to be either so unique that they have no implications whatsoever for other actions in other settings or so generalised that they apply in every possible historical and cultural setting'*.[75(p.72)] He advocated for the transferability of research results in mixed methods designs, with the focus on what can be done with the knowledge produced, rather than arguments about generalisability.

Table 2.1 Morgan's pragmatic alternative to the key issues in social science methodology.

	Qualitative approach	**Quantitative approach**	**Pragmatic approach**
Connection of theory and data	Inductive	Deductive	Abductive
Relationship to research process	Subjectivity	Objectivity	Inter-subjectivity
Inference from data	Context	Generality	Transferability

Morgan[75]

As regards pragmatism in social and health science research, Scott and Briggs argued that *'the practice of medicine can be seen as a prime example of pragmatism',*[72(p.232)] with clinical judgement at the heart of its practice. Clinical judgement can been said to be a mix of both qualitative (opinion, experience) and quantitative (test results, vital signs) data,[72] furthering the argument for undertaking research in health and related social science using a pragmatic approach.

Taking the above arguments into consideration, and with the primary focus of this research project on answering the research question/s, using whatever methods deemed the most suited to achieving this aim, a pragmatic world view was employed.

2.2.3 The purpose of mixed methods research

The early 1980s and 1990s were concerned with the development of more formal procedures for undertaking mixed methods research. It had been suggested that due to the nascent stage of the research paradigm at that time, there was insufficient agreed-upon language to sufficiently justify and explain its use,[76] leading to the rationale for the choice of mixed methods designs often not being explicitly delineated or recognised.[77] After an evaluation of 57 empirical mixed methods studies, Green et al. proposed five broad purposes for undertaking mixed methods research: triangulation, complementarity, development, initiation and expansion.[69] These purposes align with other, more recently suggested, reasons for choosing a mixed methods research design.[57, 60] In this study a mixed methods design was selected for the purposes of:

- **Complementarity** - to elaborate, enhance and clarify the results from one method with the results from the other method to provide a deeper understanding of the phenomena
- **Development** - to use the results from one method to help develop or inform the other method
- **Expansion** - to extend the breadth and range of inquiry by using different methods for different enquiry components[69]

2.2.4 Mixed methods research designs

Multiple typologies for mixed methods research designs have been proposed.[78-82] Many researchers agree on the need to reduce the number of typologies in order to simplify the field, and advocate for a shift in focus to the point of interface of the different datasets – that is, designs should be named for the purpose and timing of data integration.[83] Creswell and Plano Clark argued that the intent of the design is of primary importance, whether to explain, explore or converge, rather than the previously suggested timing or sequence.[57] Six major mixed methods designs have been described by Creswell and Plano Clark 2011.[54] A brief description of the purpose of each design is given in Table 2.2.

Table 2.2 Mixed methods research designs and purpose.

Research design	Purpose
Convergent	*To obtain different but complementary data on the same topic*
Explanatory sequential	*To use the qualitative strand to explain initial quantitative findings*
Exploratory sequential	*To use the quantitative phase to explain initial qualitative findings*
Embedded	*Used to include qualitative data to answer a secondary research question within a prominently quantitative study*
Transformative	*To conduct research that is change orientated and seeks to advance social justice. Purpose is for value-based and ideological reasons rather than reasons related to method*
Multiphase	*To address a set of incremental research questions that all advance one programmatic research objective*

Creswell and Plano Clark[54]

Within the typologies, two other core design options, fixed and emergent, have been described.[57, 77] Fixed mixed methods designs are studies where the decision to use both quantitative and qualitative methods is planned at the start of the research. Alternatively, emergent mixed methods designs generally occur *'when a second (qualitative or quantitative) method is added after the study is underway because one method has been found to be inadequate'*.[57(p.52)] However, with an emergent design, it may always have been the intent to use a mixed methods approach, but the design of the second phase could not be decided upon until the results of the first stage had been

analysed; therefore, the design *emerged*. Fixed and emergent designs are best viewed along a continuum, as many mixed methods designs fall somewhere in the middle.[57]

The current study used a multiphase, emergent mixed methods design. It was the original intention of this study to have a number of phases; however, it was not possible to know the form (and number of) these phases would take until each distinct stage was complete, making an emergent design the most suitable. Taking into consideration the suggestion of Creswell and Plano Clark[57] that a sequential explanatory design lends itself to an emergent approach, as well as the pragmatist stance that the primary focus of the project is on answering the research question/s, rather than on any one methodological approach, the current project used a multiphase, emergent mixed methods, explanatory sequential design.

2.2.5 Notation in mixed methods research

Notations are useful in helping to visualise the purpose, the timing (concurrent or sequential) and the priority of the research in a mixed methods study. Morse, who believed that in mixed methods research one approach should always be dominant over the other, designed a notation system to indicate which was the more dominant, as well as indicating the sequencing of the research design.[84] For example, QUAN → qual would indicate that the quantitative component (QUAN) takes precedence over the qualitative component (qual), with the arrow indicating that the qualitative component followed the quantitative component (i.e. a sequential study). A 'plus' sign thus '+' would indicate concurrent sequencing.[84] Creswell and Plano Clark recommended the use of a typology as a framework for beginners in the mixed methods field.[57] The current study can be notated as:

QUAN → QUAN → QUAN → qual

indicating a quantitative-dominant sequential design. Therefore, overall, the current study can be described as a multiphase, emergent mixed methods, quantitative-dominant, explanatory sequential design.

2.2.6 Integration in mixed methods research

Central to mixed methods research is the point at which data integration takes place.[66] This point of interface might occur at several stages in the process (data collection, analysis, interpretation)[78] but, as a minimum, integration should occur at the point of drawing conclusions from the overall research.[85] Integration during data analysis has been said to be *'the key to unfolding the complex relationships in the topic of study'*.[85(p. 205)] Indeed, Greenhalgh purported that it is this integration of the different data sources that ensures that all the methods have assisted in answering the research question.[62]

In an explanatory sequential design, data are integrated at the completion of the quantitative phase, to inform the direction of the qualitative phase; for example, to identify potential participants for interview and/or to develop interview questions. Data are also integrated at the interpretation phase, where the qualitative findings are used to help explain the quantitative results. In the current study, new research questions emerged following each of the three distinct quantitative phases. At the completion of the final quantitative phase (phase 3), the quantitative and qualitative phases were connected to enable the building of a profile of the types of patients identified as impacting on ED crowding, as well as to aid in designing semi-structured interview questions (Fig. 2.1). This profile was then used to recruit interview participants to participate in the final qualitative phase of the study. The quantitative and qualitative data results were integrated in the final discussion, where the qualitative findings were used to help explain the original quantitative results.

This was a multiphase project with each phase addressing different but related questions, using different procedures and designs within each phase (Table 2.3), making the design a complex one to explain. Beyond the use of simple notations, it has been recommended that procedural diagrams are used to convey the complexity of mixed methods designs.[57, 83, 86] Using the 'ten rules for drawing visual models for mixed methods designs',[86] a visual model of the multiphase, emergent mixed methods, quantitative-dominant, explanatory sequential research design used in the current thesis is depicted in Figure 2.1.

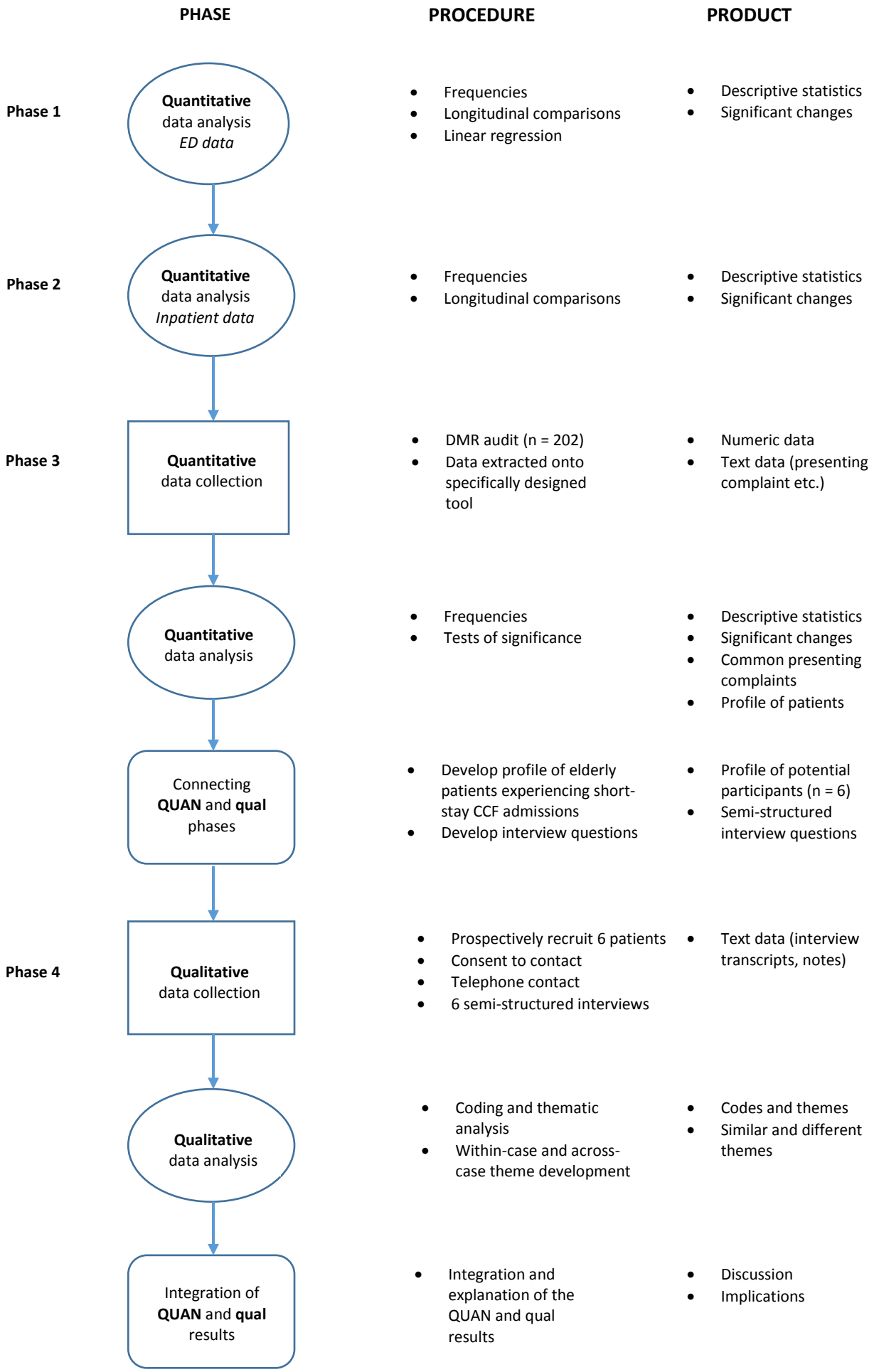

Figure 2.1 Visual model for multiphase, emergent mixed methods, quantitative-dominant, explanatory sequential design procedures.

Table 2.3 Research questions, designs and data sources in this thesis.

Phase	Research question	Design	Data source
One	What are the longitudinal patterns of ED presentations in Tasmania? Are there regional variations in patterns of ED presentations in Tasmania?	QUAN	Dataset of four years of presentations to Tasmanian EDs provided by the DHHS (2010-11 to 2013-14)
Two	What role does patient-perceived access to care, as measured by potentially avoidable admissions, play in ED presentations in Tasmania?	QUAN	Dataset of six years of admissions to Tasmanian hospitals provided by the DHHS (2010-11 to 2015-16)
Three	What are the patient and/or system level factors driving the increase in ED presentations and short-stay hospital admissions for elderly patients with congestive cardiac failure in Tasmania?	QUAN	Audit of 202 Digital Medical Records 54 records from 2010-11 (50 patients) 148 records from 2015-16 (125 patients)
Four	What role does patient-perceived access to care play in ED presentations and short-stay hospital admissions in Tasmania?	qual	Six semi-structured interviews

2.3 The current research project

Taking into consideration the current thinking on mixed methods research designs and paradigms, as well as the evolution of the research questions in this project, the research described in this thesis employed a pragmatic world view and used a multiphase, emergent mixed methods, quantitative-dominant, explanatory sequential research design to investigate the factors driving ED presentations in Tasmania (Fig. 2.1). Phase one involved a detailed quantitative analysis of four-years of ED presentations in Tasmania to describe the longitudinal patterns of ED presentations and examine regional variations. Based on the results from phase one, phase two involved a detailed quantitative analysis of six-years of hospital admissions to one hospital in Tasmania to answer the research question, *What role does patient-perceived access to care, as measured by potentially avoidable admissions, play in ED presentations in Tasmania?* Based on the results of phase two, phase three involved an audit of the DMRs of a number of patients identified in phase two as being representative of a cohort

contributing to increasing ED presentations, to answer the research question, *What are the patient and/or system level factors driving the increase in ED presentations and short-stay hospital admissions for elderly patients with congestive cardiac failure in Tasmania?*

Finally, using the results from phases 1-3, a more specific profile was developed of the types of patients contributing to increased ED presentations in Tasmania. This profile was used to prospectively recruit a sample of participants to undertake semi-structured interviews to qualitatively explore the role of patient-perceived access to care in ED presentations in Tasmania. Phase four set out to answer the research question, *What role does patient-perceived access to care play in ED presentations and short-stay hospital admissions in Tasmania* (Table 2.3)? As each phase of this study is presented in its own chapter, the specific methods used in each phase will be detailed in the relevant chapter.

2.4 Chapter summary

This chapter has provided an overview of the development of mixed methods research as a distinct research paradigm. The current thinking of methodological specialists as regards the world view, purpose, research design, and data integration in mixed methods research has been discussed. The rationale for using a multiphase, emergent mixed methods, quantitative-dominant, explanatory sequential research design in this study has been provided.

The following chapter will present, as background, the final Word document of a systematic review of the international literature on ED crowding, that has now been published.

Chapter 3. Emergency department crowding: a systematic review of causes, consequences and solutions

"In all affairs it's a healthy thing now and then to
hang a question mark on the things
you have long taken for granted."
– Bertrand Russell

This chapter was published as an original research article in the peer-reviewed, online journal *PLOS ONE* in August 2018. The final Word version of the completed manuscript in included here, with references listed at the end of this thesis. A PDF of the published manuscript is included in the appendices (appendix (i)). Two weeks after its initial publication, the journal editor elected to highlight the paper on it*'s* homepage (appendix (ii)).

Emergency department crowding: a systematic review of causes, consequences and solutions

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Abstract

Background: Emergency department crowding is a major global health care issue. There is much debate as to the causes of the phenomenon, leading to difficulties in developing successful, targeted solutions.

Aim: The aim of this systematic review was to critically analyse and summarise the findings of peer-reviewed research studies investigating the causes and consequences of, and solutions to, emergency department crowding.

Method: The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed. A structured search of four databases (Medline, CINAHL, EMBASE and Web of Science) was undertaken to identify peer-reviewed research publications aimed at investigating the causes or consequences of, or solutions to, emergency department crowding, published between January 2000 and June 2018. Two reviewers used validated critical appraisal tools to independently assess the quality of the studies. The study protocol was registered with the international prospective register of systematic reviews (PROSPERO 2017: CRD42017073439).

Results: From 4,131 identified studies and 162 full text reviews, 102 studies met the inclusion criteria. The majority were retrospective cohort studies, with the greatest proportion (51%) trialling or modelling potential solutions to emergency department crowding. Fourteen studies examined causes and 40 investigated consequences. Two studies looked at both causes and consequences, and two investigated causes and solutions.

Conclusions: The negative consequences of ED crowding are well established, including poorer patient outcomes and the inability of staff to adhere to guideline-recommended treatment. This review identified a mismatch between causes and solutions. The majority of identified causes related to the number and type of people attending ED and timely discharge from ED, while reported solutions focused on efficient patient flow within the ED. Solutions aimed at the introduction of whole-of-system initiatives to meet timed patient disposition targets, as well as extended hours of primary care, demonstrated promising outcomes. While the review identified increased presentations by the elderly with complex and chronic conditions as an emerging and widespread driver of crowding, more research is required to

isolate the precise local factors leading to ED crowding, with system-wide solutions tailored to address identified causes.

Keywords: *emergency department; crowding; demand management; accident and emergency; emergency room; emergency services; overcrowding; causes; consequences; solutions; interventions; access; utilisation; access block; boarding; systematic review*

3.1 Introduction

Emergency Department (ED) crowding has been described as both a patient safety issue and a worldwide public health problem.[26] While many countries, including Ireland,[87] Canada,[28] and Australia,[88] report significant and unsustainable increases in ED presentations, a growing number of studies have found that these increases cannot be explained by population growth alone.[88-90] Crowding in the ED can occur due to the volume of patients waiting to be seen (input), delays in assessing or treating patients already in the ED (throughput), or impediments to patients leaving the ED once their treatment has been completed (output).[8] Consequently, there are likely to be many different causes of crowding, depending on when and where in the patient journey the crowding occurs. Therefore, if the international crisis[1] of ED crowding is to be solved, it is crucial that interventions designed to resolve the problem are tailored to address identified causes.

Recognising that crowding had become a major barrier to patients receiving timely ED care, Asplin and colleagues,[8] in 2003, issued a 'call to arms' to researchers and policy makers to focus their efforts on alleviating the problem. Many answered the call, and there now exists considerable published research addressing the ED crowding agenda. Despite this, and perhaps due to the relative lack of published studies investigating the causes of crowding, many myths seem to persist as to the drivers of the problem,[91, 92] thereby making the implementation of successful, sustainable solutions difficult. A systematic and critical review of the available evidence can aid researchers, clinicians and managers to make decisions regarding the best course of action.[93]

The most recent comprehensive synthesis of the literature that we identified, investigating the causes, effects and solutions to ED crowding, was undertaken ten years ago (2008).[1] With the fast changing pace of research in the emergency medicine arena, it was anticipated that in the intervening years there would have been many developments as regards identifying both causes and consequences of ED crowding, as well as the implementation of successful solutions. The aim of this review was to expand on and provide an updated critical analysis of the findings of peer-reviewed research studies exploring the causes or consequences of, or solutions to, ED crowding.

3.2 Method

3.2.1 Definition of ED crowding

There is currently no consensus on the correct tool or unit of measurement to define ED crowding,[94] with one systematic review identifying 71 unique measures currently in use.[95] We therefore elected to include papers that had used any of the most commonly accepted metrics. These included: ED length of stay (EDLOS), rates of 'left without being seen' (LWBS) or did not wait (DNW), hours of ambulance bypass/diversion, hours of access block/boarding hours, proportion of presentations meeting nationally mandated, timed patient disposition targets (e.g. the Australian National Emergency Access Target (NEAT), the UK 4-hour target or the NZ shorter-stays-in-emergency-departments target), Emergency Department Work Index (EDWIN) score, National Emergency Department Overcrowding Scale (NEDOCS) and ED census. Some studies used more than one of these measures as the dependent variable.

3.2.2 Search strategy

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed (Appendix (iii)).[93] A search was performed on four electronic databases: Medline, CINAHL, EMBASE and Web of Science. Search terms used were: 'emergency department', 'accident and emergency', 'ED', 'emergency service' "AND" 'crowding', 'overcrowding', 'utilisation', 'congestion' "AND" "OR" 'consequences', 'outcomes', 'harm', 'negative impact', 'mortality', 'causes' 'strategies', 'solutions', 'interventions'. All research published in the English language between January 2000 and June 2018 was eligible for inclusion. There was no restriction on types of studies, with quantitative, qualitative and mixed methods studies all eligible for inclusion. Studies had to satisfy the following inclusion criteria to be considered: full text original research articles, published in peer-reviewed journals, investigating the causes and/or consequences of, and/or solutions to, crowding in general EDs. As research suggests that crowding may have different effects in paediatric populations compared to adults,[96] studies undertaken in paediatric EDs were excluded. Full details of the search strategy are available in appendix (iv).

3.2.3 Study selection, assessment and data extraction

One reviewer (CM) reviewed the titles and abstracts to identify relevant articles. Two reviewers (CM and MU) independently reviewed the full text articles to determine which of the studies met all of the inclusion criteria. Where consensus could not be reached by discussion, a third reviewer (LK) acted as adjudicator until unanimity was achieved. Two reviewers (CM and MU) used the Scottish Integrated Guidelines Network (SIGN) critical appraisal tools[97] to assess the quality of the studies. Four reviewers worked in two pairs (MU and GP, LK and JS), using a standardised form, to extract data from the included studies. Extracted data included study design, setting and population, sample size, primary and secondary outcomes, and whether consequences affected staff, patients or the system, and causes and solutions were related to input, throughput or output factors. Disagreements were resolved by discussion until a consensus was reached, with the fifth reviewer (CM) available to act as arbitrator, if required. Details of the protocol for this systematic review were registered on PROSPERO.[98]

3.3 Results

The database search returned 5,766 articles. Thirteen additional articles were added after searching the reference lists from identified studies, leaving a total of 4,131 articles after duplicates were removed. After the initial review of titles and abstracts, 162 full text articles were retrieved for full review, with 102 of these satisfying all of the inclusion criteria, and therefore included in the final review (Fig. 3.1).

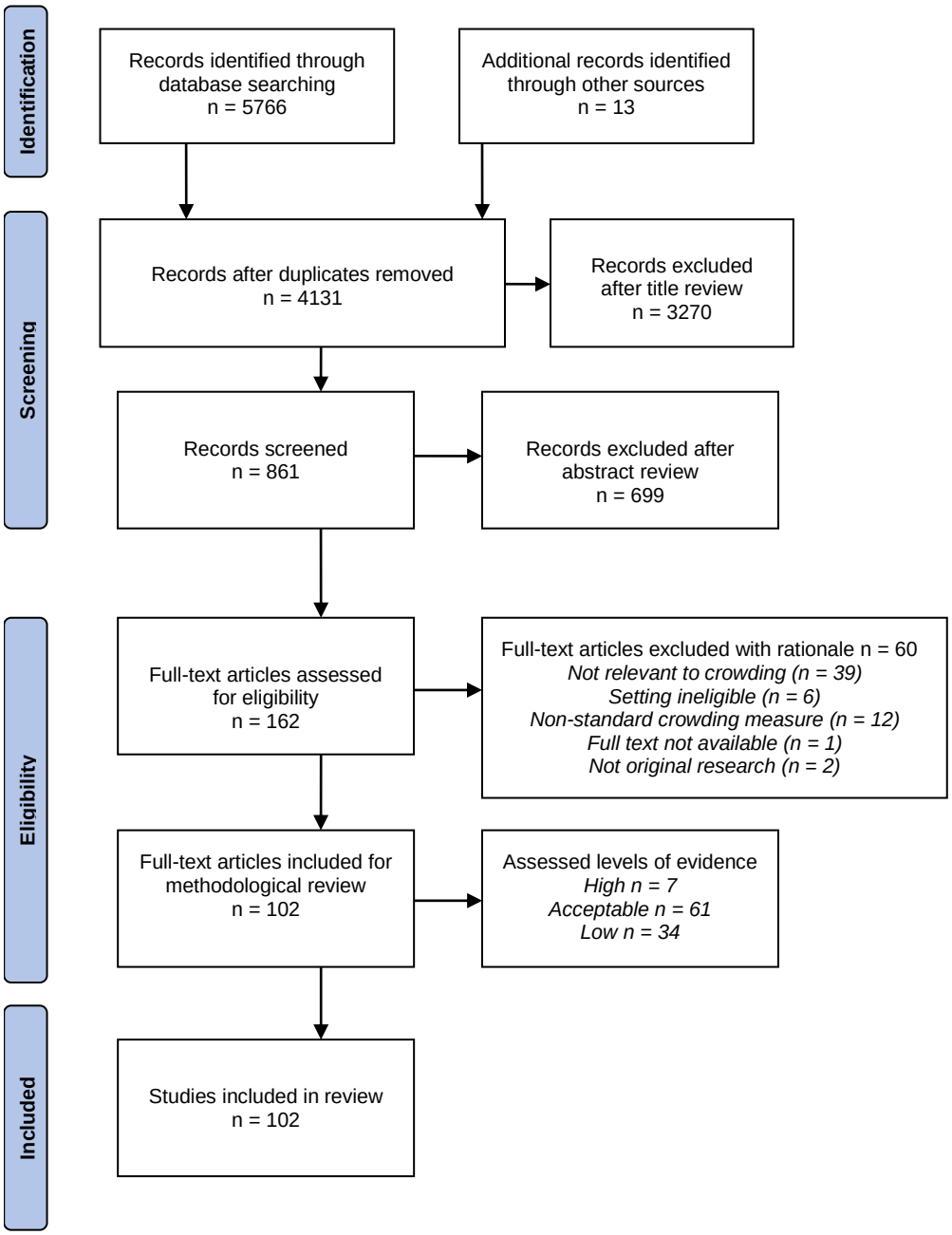

Figure 3.1 Prisma flow diagram

3.3.1 Study characteristics

The majority of studies were quantitative (95%) and retrospective in nature (87%), with eight prospective studies included, four each for studies investigating consequences[7, 99-101] or solutions.[102-105] Four randomised control trials (RTCs) evaluating potential solutions were included,[106-109] with the remaining studies being mixed methods or statistical modelling. The majority of studies were from the USA (47%), Australia (18%) and Canada (9%), with 72% of studies having been published in the previous ten years (2009-2018). The largest proportion of studies addressed either the solutions to (51%) or consequences of (39%) ED crowding (Tables 3.1 and 3.2). Only 14 included studies (14%) investigated potential causes (Table 3.3). Two studies looked at both causes and consequences,[110, 111] and two studies investigated causes and potential solutions.[101, 112]

Table 3.1 Studies investigating potential solutions to reduce ED crowding (*n*=52).

Author / Country /year	Design	Aim/s	Sample	Summary of intervention	Primary outcome measure/s	Level of evidence	Summary of findings
Anantharaman / Singapore / 2008[113]	Retrospective cohort	To review the effects of 4 social interventions on ED utilisation		1. Three public education campaigns on proper use of ED. 2. Financial disincentives for ED attendance. 3. Redirection of non-emergencies from the ED. 4. Provision of alternative clinics for those redirected and patients with minor complaints.	Average non-emergency attendance	Low	1. Smaller reductions in non-emergency attendances post each campaign. 2. Decrease in non-emergency attendances increased as ED fee increased. 3. Number of patients redirected declined over time. Scheme ceased due to adverse public relations incidents. 4. Decrease in non-emergency attendances seen with evening clinics, but time cost to ED showed no substantial benefit. Walk-in clinics had no impact on ED attendances.
Arain / UK / 2015[9]	Retrospective cohort and survey	To determine the impact of a GP-led WIC on the demand for ED care.	Minor attendances at 1 x Paediatric ED, 1 x Adult ED and 1 X MIU, 1-year pre and 1-year post opening of WIC 488 surveys competed	Opening of a GP-led WIC, 8:00-21:00 7 days a week	Minor attendances at 1 x Paediatric ED, 1 x Adult ED and 1 X MIU (Quant analysis) Attendances at the WIC by 'GP-Type' cases (Survey)	Acceptable	Significant 8.3% reduction in adult daytime GP-type attendances.
Arya / USA / 2013[114]	Retrospective chart review	To determine the effect of a split-level ESI 3 flow model on LOS for all discharged patients.	20,215 pre 20,653 post	'Splitting' of patients with ESI 3 into low and high-variability	LOS for discharged patients.	Acceptable	Significant 5.9% reduction in LOS for all patients.
Asha / Australia / 2014[115]	Pre-post, retrospective cohort	To determine if an emergency journey coordinator (EJC) improved NEAT compliance through resolving delays in patient processing	23,848 pre 20,884 post	Additional senior nursing role (EJC) in ED 7/7 from 14:30 to 23:00hrs. Conducted continuous rounds, focussed on patients approaching 2-3 hrs in ED, to identify delays and resolve issues to facilitate departure within 4 hrs.	Proportion of patients meeting NEAT. ED occupancy. Ambulance transfer of care times. LWBS rates.	Acceptable	Significant 4.9% increase in patients meeting NEAT targets. Significant decrease of 2 patients in median ED occupancy. Non-clinically significant 56-second increase in ambulance transfer of care.
Barrett / USA / 2012[116]	Pre-post, retrospective, cohort	To assess the impact of a bed management strategy on boarding time of admitted patients in the ED	10,967 ED presentations	Implementation of new positions to ensure timely identification and allocation of inpatient beds.	EDLOS. Time from decision to admit until transfer to inpatient bed. LWBS rates.	Low	21% reduction in mean EDLOS (admitted patients) 52% reduction in boarding time. 0.7% reduction in LWBS. 11% reduction in hrs of ambulance bypass.

				Improved communication around discharge and bed availability. Education for all clinical staff re new bed management policy.	Hrs of ambulance bypass. Hold hrs (time > 1 hr in ED post admission decision).		61% reduction in hold hrs.
Begaz / USA/ 2017[108]	RCT	To assess the impact of initiating diagnostic tests from the ED waiting room for patients with abdominal pain on EDLOS	848 intervention 811 control	Stable patients (usually triage cat 3) with a chief complaint of abdominal pain randomised to either undergo diagnostic testing while in the waiting room or no testing until assigned an ED bed, following a rapid medical assessment on arrival.	Time in an ED bed EDLOS LWBS rate	High	Significant 32-min reduction in mean time in an ED bed. Significant 44-min reduction in mean EDLOS.
Buckley / Australia / 2010[117]	Retrospective time series analysis	To assess the impact of an after-hours GP (AH GP) clinic on the number of daily low-urgency presentations to ED	345,465 ED presentations	Opening of a user-pays AH GP clinic in a large regional centre with one ED.	Daily ED presentations	Acceptable	Significant reduction of 7.04 patients per day (ATS 4&5) or 8.2% reduction in total presentations. Daily increase of 1.36 patients (ATS 1,2 & 3) or 1.6% in total presentations.
Burke / Australia / 2017[118]	Prospective observational	To assess the impact of a new model of care on EDLOS	35,428 intervention 35,623 Control	Combines clinical streaming, team-based assessment and senior consultation	EDLOS NEAT compliance LWBS rate	High	Significant reduction in mean EDLOS. Significant increase in proportion of patients meeting NEAT targets. Significant reduction in LWBS rate.
Burley / USA / 2007[119]	Retrospective cohort	To assess whether quality improvement initiatives can improve flow for ED admitted patients	6 months pre, 6 months post	Consensus from key stakeholders that admitted patients not remain in ED. ED patients given priority for inpatient beds. Nurse handover faxed rather than telephoned. Transportation staff placed in ED with priority given to admitted patients. Two-tiered response to capacity limitations.	Median time from bed request to assignment Median time from bed assignment to disposition EDLOS for admitted patients	Low	Significant reduction in median time from bed request to assignment in 3 of 6 months. Significant reduction in median time from bed assignment to disposition in all months. Significant reduction in median EDLOS in 5 of 6 months.
Burström / Finland / 2016[120]	Pre-post, retrospective, cohort	To assess the impact of Physician led triage on efficiency and quality in the ED	20,023 pre 23,765 post	Senior physician and nurse triage all newly arrived patients. Next a team of junior physician, I x RN and 1 x nursing assistant care for patient following a detailed protocol to preform standardised work.	Multiple time measures LWBS Unscheduled returns (24 and 74 hr) Mortality (7 and 30 day)	Low	Significant decreases in: EDLOS. LWBS rates. Unscheduled returns. Mortality within 7 and 30 days of first visit.
Cha / Korea / 2015[121]	Retrospective cohort	To determine the long-term effects of an independent	271,519 ED presentations over 6 years, 3	ICP converted ED into temporary, nonspecific ward. ED physicians assisted by specialists	EDLOS	Low	Significant decrease in EDLOS.

		capacity protocol (ICP) on ED crowding metrics	years pre, 3 years post	in determining disposition. When condition allowed, patients transferred to surrounding community hospitals.			
Chang / USA / 2018[105]	Mixed Method	To identify strategies among high-preforming, low-preforming, and high preforming improving hospitals to reduce ED crowding		No intervention. Interview data from 60 key leaders in 4 high-performing (top 5%), 4 low-performing (bottom 5%), and 4 improving hospitals		Low	No specific strategies identified. Identified 4 organisational domains associated with high performance hospitals; executive leadership involvement, hospital-wide coordinated strategies, data-driven management and performance accountability.
Copeland / Canada / 2015[12]	Pre-post, retrospective, cohort	To determine if ED fast-track (FT) is an efficient strategy to reduce wait times in a single physician coverage ED	7,432 ED visits	Open from 09:00-21:00hrs. 5 acute beds plus some chairs allocated to FT. Specially trained triage nurses allocated patients to either acute care or FT. Once a number of FT patients together, physician assessed and treated sequentially.	Wait time LOS	Acceptable	Significant 6-min reduction in medium wait time. Significant 3.6% increase in patients meeting Canadian standard time guidelines.
Dolton / UK / 2016[10]	Retrospective, case control	To evaluate the impact of a pilot of 7-day opening of GP practices on ED attendances	4 pilot GP practices 30 'control' practices	4 geographically dispersed GP clinics opened 7 days a week. Advertised in local area and at the local ED	ED attendance	Acceptable	Significant 9.9% drop in total ED attendances . Significant 17.9% drop in weekend ED attendances.
Douma / USA / 2016[109]	RCT	To evaluate the effect of 6 nurse-initiated protocols on ED crowding	67 control 76 intervention	6 updated protocols for nurse-initiated treatment commenced. Training provided to 30 nursing staff on protocol use.	Time to diagnostic test Time to treatment EDLOS	Low	Significant 186-min reduction in time to analgesic administration. Significant 79-min reduction in time to troponin measurement. Significant reduction in EDLOS for 3 of 6 protocols.
^Estey / Canada / 2003[112]	Exploratory field study	To describe the perceptions of health care professionals on potential solutions to ED crowding	Seven focus groups representing all 7 EDs in the region.	Suggestions from focus groups, no intervention		Low	Increased test turnaround-time (TAT). Better ED staffing. Faster response from admitting teams. Holding unit for admitted patients More inpatient beds 24hr outpatient appointments.
Fulbrook / Australia / 2017[122]	Non-randomised controlled trial	To assess the effect of a nurse navigator role on NEAT performance	9,822 intervention 9,951 control	Nurse navigator worked 12:30-20:30 on a week-on, week-off basis for 20 weeks.	NEAT compliance EDLOS	Acceptable	Significant increase in proportion of patients meeting NEAT targets. Significant reduction in mean EDLOS.
Han / USA / 2008[123]	Pre-post, retrospective, cohort	To determine the impact of physician triage on ED crowding measures	8, 569 ED visits pre 8,569 ED visits post	After nurse triage, a dedicated physician initiated diagnostics and treatments of patients in	EDLOS LWBS rates Ambulance diversion hrs	Acceptable	Significant 14-min reduction in EDLOS for discharged patients. Significant 2% reduction in LWBS rates. Reduction in ambulance diversion hrs.

				the waiting room, 7/7 between 13:00- 21:00hrs.			
Holroyd / USA / 2007[106]	RCT	To evaluate the implementation of triage liaison physician (TLP) shifts on ED crowding	136 shifts: 2,831 ED presentations (intervention) 133 shifts: 2,887 presentations (control)	3 x 2-week blocks where shifts randomly allocated to TLP shifts versus not (11:00-20:00hrs). TLP mitigated factors impeding throughput including: supported/assisted triage nurses, evaluated ambulance patients, initiated diagnostic studies	EDLOS LWBS rates	High	Significant 36-min decrease in EDLOS. LWBS rates decreased significantly from 6.6 to 5.4%.
Howell / USA / 2008[13]	Pre-post, retrospective, cohort	To measure the impact of an 'active bed management' intervention on EDLOS and ambulance diversion hrs	17,573 ED visits pre 16,148 ED visits post	Dedicated physician role, working in 12 hr shifts, 24/7. Physician freed from all other clinical duties. Assessed real time bed availability and made collaborative triage decisions re optimal clinical setting for patient's requiring admission. New bed director position who could call in extra staff and admit patients outside of speciality area.	Admitted and discharged EDLOS	Acceptable	EDLOS for admitted patients reduced by 98-min, with no change for discharged patients Reduction in ambulance diversion hrs
Imperto / USA / 2012[124]	Pre-post, retrospective, cohort	To determine if physician-in-triage (PIT) improves ED patient flow	17,631 patients	After nurse triage, PIT assessed and ordered diagnostics and treatments as required. Tasks performed by an RN and technician assigned to PIT.	Time to physician evaluation Median LOS Time to disposition decision LWBS rate	Acceptable	Significant reductions in: Median time to physician. Median EDLOS. Hrs on ambulance bypass.
Jang / USA / 2013[107]	RCT	To compare EDLOS between patients assigned to metabolic Point-of-care testing (POCT) versus central laboratory testing	10,244 patients	Patients randomised to either POCT or central laboratory testing	EDLOS	High	Reduced median EDLOS by 20-min in patients assigned to POCT.
Jarvis / UK / 2014[102]	Prospective, observational, cohort study	To compare the impact of an emergency department intervention team (EDIT) with a traditional nurse triage model on EDLOS	3,835 control 787 intervention	All ED patients assessed by EDIT. Nurse history, observations and administration of initial treatments, compilation and execution of an investigation plan. All discharged patients thoroughly examined by consultant. POCT utilised as appropriate.	'Time to ED ready' (i.e. time from registration to time all ED care complete). Time from arrival to first contact with clinical staff. Time from arrival to start of assessment by member of clinical staff.	High	Significant 53-min decrease in median time to ED ready. Significant 8-min decrease in median time to assessment by member of clinical staff.

				Non-discharged patients transferred to central cubicle area for traditional care.			
Jones / NZ / 2017[16]	Retrospective cohort	To assess for changes in clinically relevant outcomes after the introduction of a national target for EDLOS	5,793,767 ED presentations 2,082,374 elective admissions to 18 of 20 potential district health boards	Nationally mandated that 95% of ED presentations would be admitted, discharged or transferred within 6 hrs of arrival. Wide variety of process, staffing and structural changes implemented at different hospitals.	EDLOS IPLOS ED representations ≤ 48 hrs Readmissions ≤ 30 days Access block	Acceptable	Significant reduction of #0.29 days in median IPLOS. Significant reduction of #1.1 hrs in median EDLOS. No change in ED representations ≤ 48 hrs. Significant #1% increase in readmissions ≤ 30 days. Significant #27% reduction in access block. #Determined *a priori* to be of clinical significance.
Kelen / USA / 2001[103]	Prospective, pre-post, observational	To determine the impact of an inpatient, ED-managed acute care unit (ACU) on ED overcrowding	10,871 ED presentations, 1,587 patients in the ACU (14.4% of ED census)	Opening of a 14-bed monitored unit, located at a distance remote to the ED, within the hospital. Staffed by ED personnel. Designed to accept ED patients who required observation or management for > 4 hrs.	LWBS rates. Hrs of ambulance diversion.	Acceptable	Significant decrease in LWBS rates. Significant decrease in hrs of ambulance diversion.
Kim / Korea / 2012[125]	Retrospective cohort	To evaluate the effects of a short text message reminder to decision makers who delay assessing patients in the ED on EDLOS	1,693 consulted patients pre 1,642 consulted patients post	2-4-8 SMS project. When no decision on patient disposition entered on computer 2 hrs post referral, SMS reminder sent to resident. Same at 4 hr mark. Admissions delayed 8 hrs, SMS sent to relevant faculty/admissions office.	EDLOS Consultation time Disposition time Boarding time	Low	Significant 36-min reduction in median EDLOS for admitted patients. No effect on consultation time. Significant decreases in disposition and boarding time.
Lauks / Holland / 2016[126]	Pre-post, retrospective, cohort	To assess the impact of implementing medical team evaluation (MTE) in the ED	47,743 ED visits	Physician teamed with a triage nurse, 7/7, between 09:00-22:00hrs. Physician initiated diagnostics and treatments and discharged ESI 5 patients.	Door-to-doctor time EDLOS	Acceptable	Significant 30-min decrease in median door-to-doctor time. Significant 15-min increase in median EDLOS.
Lee / Taiwan / 2017[127]	Retrospective cohort	To assess the impact of high turnover 'ED utility beds' on ED crowding	70,515 control 69,706 intervention	14 beds for ED patient use only with strict regulations to govern occupancy. Restriction of 48-hr limit for each patient	EDLOS LWBS rates	Acceptable	Significant 1.7-hr decrease in mean EDLOS for all admitted non-trauma patients. No change in EDLOS for discharged patients. No change in rates of LWBS.
Lee-Lewandrowski / USA / 2003[128]	Pre-post, retrospective, cohort	To investigate the impact of a POCT satellite laboratory in the ED	369 patients	Clinicians had option of central laboratory or POCT for urinalysis, pregnancy testing, cardiac markers and glucose.	Test TAT EDLOS	Low	87% reduction in test TAT. Significant 41-min decrease in EDLOS for combined patients having 3 tests (excluding glucose). No significant decrease for patients having single test.

							EDLOS for patients who did not receive POCT increased by non-significant 11-min.
Lee-Lewandrowski / USA / 2009[129]	Pre-post, retrospective, cohort	To evaluate the impact of implementing rapid D-dimer testing in an ED satellite laboratory	252 patients pre 211 patients post	24 hr satellite laboratory in the ED had ability to undertake rapid D-dimer testing.	Test TAT EDLOS	Low	79% decrease in test TAT. Significant 1.32-hr decrease in mean EDLOS for patients who received D-dimer testing.
Mason / UK / 2011[130]	Retrospective data analysis	To evaluate the effect of the mandated ED care intervals in England	735,588 ED visits from 15 hospitals over 4 years. Mix of high, middle and low performing	Nationally mandated 4-hr target for patient disposition for 98% of ED presentations. Specific interventions not detailed but hospitals expected to adopt a whole-systems approach.	EDLOS Time to first ED clinician review	Acceptable	Proportion leaving ED within 4 hrs increased from 83.9 to 96.3%. Median EDLOS for admitted patients decreased by 25-min.
McGrath / USA / 2015[131]	Retrospective cohort	To evaluate the impact of a flexible care area (FCA) on ED throughput measures	417 days over 2 years when FCA was operational	3 roomed area staffed by ED physician, RN and ED technician from 16:00-23:00hrs. Prioritised moderate acuity to expedite ordering of diagnostics.	EDLOS LWBS rate	Low	Significant decrease in EDLOS for some ESI categories. Significant reduction in rates of LWBS.
McHugh / USA / 2013[132]	Retrospective, cross-sectional	To evaluate the efforts of five hospitals (a-e) that introduced various interventions to reduce ED crowding		a. PIT. b. Faxed report from ED to admitting unit and bed coordinator. c. Adoption of ESI triage scale, bedside registration and staff resourcing for ED fast-track area. d. More efficient intake process for non-urgent patients. e. Improved process to request specialist consults.	EDLOS LWBS rates	Low	a. Significant reduction in EDLOS for mid-acuity patients (target group). b. Significant reduction in LWBS rates. c. Significant reduction in EDLOS. d. Significant reduction in EDLOS. e. Increase in EDLOS.
Mumma / USA / 2014[133]	Retrospective cohort	To determine the effects of ED expansion on ED crowding	42,896 pre 48,358 post	ED expanded from 33 to 53 beds. No substantial changes to physician staffing or nurse/technician to patient ratios.	LWBS rates Daily boarding hrs	Low	No change in LWBS rates. Significant increase in boarding hrs from 160-hrs per day to 180-hrs per day.
Nagree / Australia / 2004[134]	Retrospective, cohort	To model the capacity of after-hours GP services to reduce low acuity presentations (LAPs) to metropolitan EDs	183, 424 ATS 3-5 patients	No intervention. Modelling the impact of AH GP services.	Excess LAPs	Acceptable	After-hours GP services for LAPs are unlikely to significantly reduce total ED attendances or costs.
Ngo / Australia / 2018[135]	Retrospective cohort	To assess the impact of the Western Australia (WA) 4 hr target on ED	3,214,802 ED presentations across 5 hospitals	Implementation of a 4-hr rule (NEAT) whereby 90% of ED patients in the state of WA were to be admitted, discharged or	Access block ED occupancy rate ED re-attendances ≤ 1 week	Acceptable	Significant decrease in percentage of access block at all hospitals. Significant decrease in median ED occupancy at 4 of 5 hospitals.

		functioning and patient outcomes	(2002-2013)	transferred within 4 hrs of arrival	EDLOS		Significant decrease in median EDLOS at 4 of 5 hospitals.
Partovi / USA / 2001[136]	Retrospective, cohort	To investigate the effect of Faculty triage on EDLOS	8 intervention days 8 'control' days	A faculty member was added to the triage team of 2 nurses and one emergency medicine technician. Their role included: rapid evaluation, move serious patients to main area, order diagnostics and fluids, discharge simple cases and encourage rapid registration.	Nurse triage time Nurse discharge time LWBS rates	Low	Significant 82-min reduction in mean EDLOS.
Patel / USA / 2014[137]	Pre-post, retrospective, cohort	To assess the effect of a leadership-based program to expedite hospital admissions from the ED	25 months pre 47 months post	Team of hospital leaders convened. Computerised tracking system used to monitor ED bed status in real time. Agreement to admit patients within 1 hr of decision to admit.	Proportion of ED patients admitted to inpatient bed within 60 mins of bed request	Acceptable	Significant 16% increase in proportion of patients admitted within 60-mins of bed request.
Perera / Australia / 2014[138]	Pre-post, retrospective, cohort	To assess the effect of NEAT on common crowding metrics	76,935 patients	Hospital-wide education program to increase awareness of NEAT initiative.	EDLOS IPLOS Proportion of admissions meeting NEAT Mortality rates	Acceptable	Significant improvements in: EDLOS. NEAT admission targets. Access block. Significant increase in IPLOS. No change to mortality rates.
Quinn / USA / 2007[14]	Pre-post, retrospective, cohort	To determine the impact of a rapid assessment policy (RAP) on EDLOS	10,153 pre 10,387 post	ED physicians directly admit patients to inpatient beds. Admitting physicians not required to assess patients in the ED prior to admission. No requirement for all laboratory and radiological test results to be complete prior to admission.	EDLOS Time on ambulance diversion. LWBS rates.	Acceptable	Significant 10-min decrease in EDLOS. Significant 65% decrease in hrs of ambulance diversion.
Sharma / Australia / 2011[139]	Statistical modelling	To model the determinants of duration of wait of ATS 2 patients in an ED and test whether diverting ATS 5 patients away from the ED, or increasing ATS 5 patients' choice of EDs reduces ED waiting times for ATS 2 patients.	84,291 ATS 2 199,973 ATS 5	No intervention. Modelling the impact of co-located GP and choice of ED for ATS 5 patients on outcomes for ATS 2 patients	EDLOS	Low	Co-located GP significantly reduced mean wait of ATS 2 patients by 19%. Increasing choice of ATS 5 patients beyond a certain number of ED options had a negative effect on duration of wait for ATS 2 patients.

Shetty / Australia / 2012[104]	Prospective, interventional	To assess the impact of the 'Senior Streaming Assessment Further Evaluation after Triage (SAFE-T) zone' concept on ED performance	10,185 pre 10,713 post	Developed an assessment zone around triage to facilitate early physician review, disposition decision-making, and streaming to bypass the ED acute area.	EDLOS LWBS rates	High	Significant reductions in: EDLOS for ATS 2-5. LWBS rates.
Shin / Korea / 2017[140]	Retrospective cohort	To measure the effect of an improved speciality consultation process on EDLOS	6,967 pre 7,301 post	Between 7am and 6pm only senior emergency physicians (as opposed to emergency residents) consult internal medicine (IM) physicians re patients requiring admission. If required, the IM physician reviews the patient in the ED and organises prompt resident review for admission.	EDLOS of IM patients Admission order to ED departure Overall EDLOS Discharged EDLOS	Acceptable	Significant 290-min reduction in mean EDLOS. Significant 120-min decrease in mean time. from admission order to ED departure No change to overall EDLOS. No change to discharged EDLOS.
Singer / USA / 2008[141]	Retrospective, cohort	To investigate the effect of a dedicated ED 'stat' laboratory on EDLOS	5,631 ED visits pre 5,635 ED visits post	A stat laboratory dedicated to ED patents set up within the main laboratory, staffed by dedicated personnel, 24/7	EDLOS for admitted patients	Low	Significant 21-min reduction in median EDLOS for all patients with laboratory tests performed. Significant 62-min reduction in median EDLOS for admitted patients with laboratory tests performed.
Sullivan / Australia / 2014[11]	Retrospective, pre-post, interventional	To evaluate the effect of various reforms (throughput and output) to meet the NEAT target of disposition from ED within 4 hrs	All ED presentations for the same 3-month periods in 2012 (pre), 2013 (post) and 2014 (maintenance)	Senior staff taskforce set up to provide oversight, direction and monitor NEAT compliance. Business intelligence unit set up to make reporting transparent. Compliance seen as whole-of-hospital flow problem. Major redesign of clinical processes, including bed management operations.	Proportion of patients exiting ED within 4 hrs Mean transit times within the ED Inpatient mortality LWBS rates 48 hr representation rates	Acceptable	Significant increase in: Proportion of patients exiting ED within 4 hrs. Mean transit times within the ED. Significant decrease in: Inpatient mortality. LWBS rates.
Takakuwa / USA / 2006[142]	Retrospective, cohort	To investigate the effect of bedside registration on EDLOS	52,225 patient encounters	When beds were available, patients brought immediately back to patient care area following triage where they were registered by a clerk whilst being simultaneously assessed by medical staff.	Time from triage-to-room Time from room-to-disposition	Low	Significant decrease in time from triage-to room with bedside registration for non-urgent patients.
Tenbensel / NZ / 2017[17]	Mixed method	To assess the impact of a national 6 hr target for ED admissions on EDLOS To identify particular actions that impacted	4 hospitals covering 25% of NZ population 68 semi-structured interviews	Nationally imposed target of 95% of all ED presentations seen, treated or discharged within 6 hrs.	Reported EDLOS Total EDLOS (includes time in short-stay unit) Staff perceptions of successful interventions	Acceptable	Reductions in median reported EDLOS in all hospitals. Smaller reductions in median total EDLOS in all hospitals. ***Results from interviews*** Hospital leadership prior to target.

		on identified reductions in EDLOS					New resources (beds and staff). Processes to improve flow within the ED and hospital wide. Improved information and communication.
van der Linden / Holland / 2013[143]	Retrospective, cohort	To investigate the effect of a flexible acute admissions unit (FAAU) on EDLOS for admitted patients and inter-hospital transfers	8,377 ED visits pre 8,931 ED visits post	Between 4pm and 8am daily at least 15 potential FAAU beds were identified across several inpatient units. During office hours, patients were transferred back to 'home' departments where possible. Employment of an 'admissions coordinator' who assessed the bed status in real time.	Number of admissions transferred to other hospitals EDLOS for patients requiring 'regular' admission (non-specialist) EDLOS for discharged patients	Low	Significant decrease in number of patients transferred to other hospitals due to bed unavailability. No change in EDLOS for patients admissible. to FAAU in comparison to increased EDLOS for 'other' admissions.
^van der Linden / Holland / 2017[101]	Mixed Method	To compare staff perceptions of causes and solutions of ED crowding in two EDs: one in Pakistan and one in The Netherlands	18 one-hour staff interviews 12 in Pakistan 6 in The Netherlands	Suggestions from interviews, no intervention.		Low	An additional triage room. More staff to reduce delays in decision to admit. More efficient processes for bed management and diagnostics. An acute admissions unit. More effective bed coordination.
^White / USA / 2012[144]	Pre-post, retrospective, cohort	To assess the impact of 'Supplemented Triage and Rapid Treatment' (START) on ED throughput	12,936 pre 14,220 post	After nurse triage, non-FT patients assessed by a physician who ordered diagnostics and identified patients whose disposition could be accelerated without further need for clinical work-up in the ED.	EDLOS LWBS rates	Acceptable	Significant decrease in: Median EDLOS. LWBS rates.
Whittaker / UK / 2016[145]	Retrospective cohort	To investigate the association between extending GP opening hrs and ED visits for minor injuries	2,945,354 ED visits	4 'schemes' (each scheme serves population of 200-300,000 people) received funding to provide additional urgent and routine GP appointments between 5-9pm Mon-Fri and on both days of the weekend.	Per capita (per 1,000) patient-initiated ED referrals for minor problems Total ED visits	Acceptable	Significant 26% relative reduction in patient-initiated ED referrals for minor problems in intervention practices. Insignificant 3.1% relative reduction in total ED visits.
Willard / USA / 2017[146]	Retrospective cohort	To examine the effectiveness of a Full Capacity Protocol (FCP) to reduce ED crowding	20,822 ED encounters control 22,357 ED encounters intervention	A predetermined response to specific circumstances in the hospital and ED. Additionally, can be activated by ED coordinator in response to reduced throughput. When activated, hospital leaders gather in ED to collaboratively identify and remove barriers to obtaining disposition.	LWBS rates EDLOS Ambulance diversion hrs	Acceptable	10.2% non-significant decrease in LWBS rates. Significant 34-min increase in mean EDLOS. Significant 92% decrease in total hrs of ambulance diversion.

^Papers also looked at causes of crowding
ACU = acute care unit AH = after hours ATS = Australian triage scale ED = emergency department EDIT = emergency department intervention team EDLOS= emergency department length of stay
EJC = emergency journey coordinator ESI = emergency severity index FAAU = flexible acute admissions unit FCA = flexible care area FCP = full capacity protocol FT = fast-track GP = general practitioner
ICP = independent capacity protocol IM = internal medicine IPLOS = inpatient length of stay LAP = low-acuity presentation LOS = length of stay LWBS = left without being seen MIU = minor injury unit
MTE = medical team evaluation NEAT = National Emergency Access Target PIT = physician in triage POCT = point-of-care test RAP = rapid assessment policy RN = registered nurse
SMS = short-message-service TAT = turnaround-time TLP = triage liaison physician WIC = Walk-in centre

Table 3.2 Studies investigating potential consequences of ED crowding (*n*=40).

Author/ Country /year	Design	Aim/s	Sample	Primary outcome measure/s	Level of evidence	Summary of findings
***Bond / Canada / 2007**[110]	Non-comparative survey	To investigate the frequency, determinants and impacts of ED crowding	158 ED Directors	Frequency, determinants and impacts of ED crowding	Low	Increased stress of clinical staff. Increased wait times. Provider dissatisfaction. Risk of poor patient outcomes and delay in improvements in patients' wellbeing.
Chiu / Taiwan / 2018[147]	Retrospective cohort	To investigate the effect of crowding on clinical efficiency, diagnostic tool use and patient disposition	70,222 ED visits in 2 EDs	Time to disposition decision EDLOS Patient disposition Diagnostic interventions ordered	Acceptable	Increased odds of being admitted in times of crowding. Slightly increased odds of CT scanning and laboratory testing during crowding.
***Derlet / USA / 2002**[111]	Non-comparative survey	To determine the incidence, causes and effects of crowding in EDs in three US states	210 ED directors	Incidence, causes and effects of ED crowding	Low	Delayed commencement of therapy across a range of conditions leading to poor outcomes for patients
Diercks / USA / 2007[148]	Secondary data analysis from an observational registry	To evaluate the association between EDLOS, guideline-adherence to recommended therapies and clinical outcomes of patients presenting to the ED with non-ST-segment-elevation myocardial infarction (non-STEMI)	42,780 patients with non-STEMI	Adherence to 5 acute guideline medication recommendations (defined as receiving medications within 24-hrs) Occurrence of in hospital adverse events (death, recurrent MI)	Acceptable	Long ED stays associated with decreased use of guideline-recommend therapies and a higher risk of recurrent MI. No observed increase in inpatient mortality.
Fee / USA / 2007[149]	Retrospective cross-sectional, chart review	To determine the association between ED volume and timing of antibiotic administration in patients admitted via the ED with	405 patients with CAP	Did/did not receive antibiotics within 4 hrs in relation to total ED volume. Time to antibiotics in relation to number of patients in the ED who were ultimately admitted.	Acceptable	Higher ED volume independently associated with a lower likelihood of patients with CAP receiving antibiotics within 4-hrs (OR 0.96 per additional patient). Number of patients in the ED ultimately admitted had a slightly stronger, but non-significant, effect than the number of

		community acquired pneumonia (CAP)				patients ultimately discharged, on time to antibiotics (OR 0.93 vs. 0.97).
Gaieski / USA / 2017[150]	Retrospective cohort	To investigate the hypothesis that ED crowding would impact negatively on the care of patients with severe sepsis or septic shock	2,913 patients with severe sepsis	Time to administration of intravenous fluids (IVF) Time to administration of antibiotics Initiation of protocolized care (Y/N) Inpatient mortality	Acceptable	ED occupancy had significant negative impact on odds of patients receiving IVF within ≤ 1 hr and antibiotics within ≤ 3 hrs. Number of boarders in the ED had significant negative impact on the odds of receiving protocolized care. No impact on inpatient mortality.
Guttmann / Canada / 2011[28]	Retrospective cohort	To determine whether patients discharged from the ED during shifts with long waiting times are at risk for adverse events	13,934,542 patients discharged from ED	Admission to hospital or death within seven days	Acceptable	Patients presenting to EDs during shifts with long mean waiting times might be at increased risk of death and admission in subsequent 7-days, regardless of acuity on presentation.
Hwang / USA / 2006[151]	Retrospective cohort	To evaluate the effect of ED o/c on assessment and treatment of pain in older adults with a hip fracture	158 patients	Documented pain assessment Time to pain assessment Documentation and administration of analgesic Type of analgesic administered	Low	When the ED was at > 120% capacity there was a significant reduced odds of patients having their pain documented on first assessment and a longer time to pain assessment. No impact on time to administration of analgesic.
Hwang / USA / 2008[152]	Retrospective cohort	To evaluate the association of ED crowding factors with quality of pain care	1,068 ED visits	Time to documented pain assessment Time to medications ordered and administered Type of analgesia ordered	Acceptable	ED census directly associated with significant delays in: Pain assessment Time to analgesic ordering and administration
Jo / Korea / 2015[153]	Retrospective cohort	To evaluate the association between ED crowding and inpatient mortality among critically ill patients admitted through the ED	1,801 critically ill patients (systolic BP < 90mmHg)	Inpatient mortality	Acceptable	ED crowding associated with increased inpatient mortality.
Kulstad / USA / 2009[154]	Retrospective cohort	To determine the association between percutaneous coronary angiogram (PCI) for patients presenting to ED with an acute myocardial infarction (AMI) and ED crowding	17 patients who underwent PCI over a 2-month period	Time to first Electro-cardiogram (ECG) Time to arrival at cardiac catheterisation lab (CCL) Time to first balloon inflation	Low	No relationship between time to ECG and time to arrival in the CCL and crowding. Significant delay in time to balloon inflation during times of crowding (p=0.008).
Kulstad / USA / 2010[99]	Prospective, observational	To determine the association between ED crowding and the frequency of medication errors	6,728 EDWIN scores and 283 medication errors	Correlation between the average daily EDWIN score and total number of daily medication errors detected	Low	Significant positive correlation between average daily EDWIN score and medication error frequency (p=0.001).
Lee/ Taiwan / 2012[100]	Prospective, chart review	To investigate the factors related to blood culture contamination in the ED	558 patients with positive blood cultures	Rates of contaminated blood cultures in relation to ED crowding as measured by the NEDOCS	Low	ED overcrowding independently associated with contaminated blood cultures (OR 1.58, p=0.04). Strong correlation between contamination rate and degree of ED crowding (Pearson correlation=0.99, p=0.001)

Liew / Australia / 2003[155]	Retrospective cohort	To examine the association between EDLOS and IPLOS	17,954 admissions	Mean IPLOS Excess IPLOS	Low	EDLOS is associated with excess IPLOS.
Liu / USA / 2011[156]	Retrospective cohort	To examine the relationship between ED boarding and quality of care amongst patients admitted for chest pain, pneumonia or cellulitis	1,431 patients included	Medication delays and errors. Adverse events.	Acceptable	Boarding time associated with home medication delays (AOR 1.07 CI 1.05-1.10).
McCarthy / USA / 2009[157]	Retrospective cohort	To quantify the relationship between ED crowding and EDLOS	235,928 ED visits at 4 EDs	Waiting room time Treatment time Boarding time	Acceptable	Crowding delayed waiting room and boarding time but not treatment time. Crowding delayed the care of ATS 2 patients at all sites.
McCusker / Canada / 2014[158]	Retrospective cohort	To examine the association of ED occupancy with patient outcomes	677,475 patients at 42 EDs	Deaths at 30 days for both admitted and discharged patients Return ED visits for discharged patients Admission following return ED visit	Acceptable	A 10% increase in ED bed relative occupancy ratio was associated with a significant 3% increase in death.
Medley / USA / 2012[5]	Retrospective chart review	To determine if there is an association between ED occupancy rates and violence towards ED staff	278 included cases	The presence of violent incidents	Acceptable	A significant association between crowding and violence towards staff.
Mills / USA / 2009[159]	Secondary data analysis from a prospectively collected database	To evaluate the association between ED crowding and analgesic administration in adult ED patients with acute abdominal pain	976 patients with abdominal pain	Receipt of analgesia Delays in administration of analgesia	Acceptable	ED crowding not associated with failure to treat with analgesia. Higher crowding levels in ED independently associated with significant delays in administration of analgesia.
Nippak / Canada / 2014[160]	Retrospective cohort	To identify the relationship between EDLOS and IPLOS	4,743 ED visits	EDLOS IPLOS	Low	Positive significant correlation between EDLOS and IPLOS.
Pines / USA / 2006[161]	Cross-sectional, data-linkage	To assess the association between ED crowding and antibiotic timing in pneumonia and PCI in AMI	Administrative data from 24 EDs	Time to antibiotic administration in patients with pneumonia Time to PCI in patients with AMI	Low	An increase in overall EDLOS associated with a significant decrease in percentage of patients receiving antibiotics within 4-hrs ($p = 0.04$). No association between ED crowding measured and time to PCI for patients with AMI.
Pines / USA / 2007[162]	Retrospective cohort	To assess the impact of ED crowding on delays in antibiotic administration for patients with community acquired pneumonia (CAP)	694 patients with CAP	Time from patient triage until antibiotic administration	Acceptable	Crowding in the ED is related to delayed and non-receipt of antibiotics in patients with CAP.
Pines / USA / 2008[3]	Retrospective cohort	To study the impact of ED crowding on ED patients with severe pain	13,758 patients	Receipt of any analgesia Delay of > 1-hour from triage to receipt of analgesia Delay of > 1-hour from arrival in a treatment room to receipt of analgesia	Acceptable	Increasing levels of ED crowding were significantly associated with failure to treat or delayed treatment with analgesia.

Pines / USA / 2009[163]	Retrospective cohort	To examine whether ED crowding was associated with adverse cardiovascular outcomes in patients with chest pain syndrome	4,574 patients	The development of an adverse cardiovascular outcome that was not present on ED arrival, but that occurred during hospitalisation	Acceptable	A positive association between some measures of ED o/c and rates of adverse cardiovascular outcomes.
Pines / USA / 2010[164]	Retrospective cohort	To study the association between ED crowding and the use of, and delays in administration of analgesia in patients with back pain	5,616 patients	Receipt of any analgesic Time to administration of analgesia	Acceptable	Higher crowding levels in the ED independently associated with significant delays in analgesia administration.
Reznek / USA / 2016[165]	Retrospective cohort	To investigate the hypothesis that ED crowding is associated with longer door-to-imaging time (DIT) in patients with acute stroke	463 patients	DIT ≤ 25-mins (Y/N)	Acceptable	Crowding had a significant negative impact on DIT.
Richardson / Australia / 2002[166]	Retrospective cohort	To assess the relationship between access block in the ED and IPLOS	11,906 admissions	EDLOS and IPLOS	Acceptable	Patients who experienced access block had a significant mean IPLOS 0.8 days longer than those who did not experience access block.
Richardson / Australia / 2006[167]	Retrospective stratified cohort	To quantify any relationship between ED o/c and 10-day inpatient mortality	34,377 patients (o/c shifts) 32,231 patients (non-o/c shifts)	In-hospital death recorded within 10-days of most recent ED presentation	Acceptable	ED patients presenting in times of o/c had significantly higher 10-day in-hospital mortality than those presenting to a non-o/c ED.
Richardson / Australia / 2009[168]	Retrospective cohort	To identify any relationship between access block and the time to definitive care of patients with fractured neck of femur.	369 cases of fractured neck of femur	Time to surgery (< 24 hrs = 'timely') in relation to ED crowding as measured by access block occupancy (ABO) quartile	Acceptable	Significant relationship between ABO quartile at presentation and delayed surgery (p=0.006).
Sikka / USA / 2010[4]	Retrospective cohort	To measure the correlation between ED occupancy rate and time to antibiotic administration for patients with pneumonia	334 patients	Initial antibiotic administration within 4-hrs of ED arrival	Acceptable	Significant negative association between time to antibiotic treatment and ED crowding, as measured by ED occupancy rate.
Singer / USA / 2011[169]	Retrospective cohort	To explore the association between ED boarding and clinically important patient outcomes	41,256 admissions from the ED	In-hospital mortality	Acceptable	Prolonged ED boarding negatively associated with significant increase in in-hospital mortality and significant increase in IPLOS.
Sprivulis / Australia / 2006[170]	Retrospective cohort	To examine whether high hospital occupancy and ED access block are associated with increased inpatient mortality	62,495 hospital admissions	Deaths on days 2 ,7 and 30 evaluated against an overcrowding hazard scale	Acceptable	Hospital and ED o/c is associated with a 30% relative increase in mortality by Day 2 and Day 7 for patients requiring admission via ED to an inpatient bed.
Sun / USA / 2013[6]	Retrospective cohort	To assess the association of ED crowding with subsequent outcomes in a general population	995,379 ED visits resulting in admission to 187 hospitals	Inpatient mortality	Acceptable	High ED crowding associated with: 5% greater odds of inpatient death 0.8% increase in IPLOS

Tekwani / USA / 2013[171]	Retrospective cohort and patient survey	To evaluate the impact of ED crowding on satisfaction of patients discharged from the ED	1,591 patient satisfaction scores over 497 8-hr shifts	Mean patient satisfactions scores Modified EDWIN score ED census Ambulance diversion rate	Low	ED crowding significantly associated with decreased patient satisfaction ($p < 0.001$).
Tsai / Taiwan / 2016[172]	Retrospective cohort	To investigate the impact of crowding and number of ED staff on efficiency of ED care processes for patient with acute stroke presenting ≤ 3 hrs of symptom onset	1,142 acute stroke patients	Door-to-assessment time (DTA) Door-to-computed tomography completion time (DTCT) Door-to-needle (DTN) time where appropriate	Low	DTA and DTCT times significantly increased in times of crowding. No effect on DTN time.
van der Linden / Holland / 2016[173]	Retrospective Chart review	To assess the impact of ED crowding on triage processes	45, 539 ED presentations	Target time to triage (mandated target time = 10-mins) Any triage score assigned	Acceptable	ED crowding associated with: significant delay in target time to triage significant number not assigned a triage score
Verelst / Belgium / 2015[7]	Prospective observational	To determine whether ED crowding was independently associated with in-hospital death within 10 days of ED admission	32,866 admissions	Risk-adjusted HR for in-hospital death occurring within 10-days of ED admission in crowding quartile 4 vs. occupancy quartiles 1, 2 and 3	High	No significant association between ED crowding and overall risk of mortality.
White / USA / 2013[174]	Retrospective cohort	To investigate the effect of boarding hospital inpatients in the ED on LOS of patients discharged from the ED	179,840 discharged patients	Discharged patient LOS	Acceptable	As boarder burden increased, EDLOS for discharged patients increased by 10%.
Wickham / Sweden / 2017[175]	Retrospective cohort	To investigate the effect of crowding on EDLOS of ten most common medical or surgical complaints	19,200 ED visits 4,456 high acuity 14,744 low acuity	Median EDLOS for 10 chief complaints, stratified by high acuity (triage scores 1&2) and low acuity (triage scores 3-5)	Acceptable	Significant 46% increase in EDLOS for high acuity patients in times of crowding, true for all complaints except 'wound'. Significant 82% increase in EDLOS for low acuity patients in times of crowding, true for all 10 conditions studied.
Zhou / China / 2012[176]	Retrospective cohort	To investigate whether patients boarded in the ED are subjected to increased serious complications	20,276 admitted patients	New onset of shock Need for intubation Death within 24-hrs of decision to admit	Acceptable	Positive correlation between high daily hospital occupancy and rates of shock and intubation, but not death within the initial 24-hrs post-admission request.

*Papers also looked at causes of crowding

ABO = access block occupancy AMI = acute myocardial infarction AOR = adjusted odds ratio ATS = Australian triage scale BP = blood pressure CAP = community acquired pneumonia CCL = cardiac catheterisation laboratory CT = computerised tomography DIT = door-to-imaging time DTA = door-to-assessment time DTCT = door-to-computed-tomography time DTN = door-to-needle time ECG = electrocardiograph ED = emergency department EDLOS = emergency department length of stay EDWIN = Emergency Department Work Index HR = hazards ratio IPLOS = inpatient length of stay IVF = intravenous fluid NEDOCS = National Emergency Department Overcrowding Scale o/c = overcrowding/ed OR = odds ratio PCI = percutaneous coronary angiogram

Table 3.3 Studies investigating potential causes of ED crowding (n=14).

Author / Country /year	Design	Aim/s	Sample	Outcome measure/s	Level of evidence Quality assessment	Summary of findings
Aboagye-Sarfo / Australia / 2015[177]	Population-based longitudinal study	To analyse recent trends and characteristics of ED presentations in Western Australia (WA)	All ED presentation in WA between 2007-2013	Annual number and rates of ED presentations	Acceptable	Key drivers of increased ED presentations (4.6% annually) were people with urgent and complex care needs.
***Bond / Canada / 2007**[110]	Non-comparative survey study	To investigate the frequency, determinants and impacts of ED crowding	158 ED Directors	Frequency, determinants and impacts of ED crowding	Low	Access block. EDLOS. Increased complexity and acuity of patients. Lack of access to primary care. Non-urgent patients.
***Derlet / USA / 2002**[111]	Non-comparative survey study	To determine the incidence, causes and effects of o/c in EDs in three US states	210 ED directors	Incident, causes and effects of ED o/c	Low	Access block. Increased severity of conditions. Increased ED volume.
Cowling / UK / 2013[178]	Cross-sectional, population based	To examine the association between access to primary care and ED visits	7,856 GP practices	Number of self-referred, discharged, ED visits by the registered population of a general practice	Acceptable	Significantly less self-referred, discharged, ED visits from practices that provided timely access.
Dunn / Australia / 2003[179]	Pre-post, retrospective, cohort	To determine if changes in hospital occupancy would affect ED occupancy and ED wait time performance	1,133 ED visits pre 2,332 ED visits post	Hospital occupancy Access block days EDLOS LWBS rate	Acceptable	Significant decrease in: Hospital occupancy Access block days EDLOS LWBS rate
^Estey / Canada / 2003[112]	Exploratory field study	To describe the perceptions of health care professionals regarding service pressures that result in ED overcrowding	Seven focus groups representing all 7 EDs in the region. Groups consisted of ED physicians (8), ED managers (8), and other ED staff including nursing and allied health (42).		Low	Shortage of inpatient beds. Change of role of ED as 'holding unit' for the rest of the healthcare system. Shortage of nursing staff. Limited access to diagnostic services. Increased numbers of high-acuity, elderly patients.
Fatovich / Australia / 2005[180]	Retrospective data analysis	To systematically evaluate the relationship between access block, ED o/c, ambulance diversion and ED activity	259,580 ED attendances	Hrs on ambulance diversion Hrs of access block	Acceptable	Ambulance diversion and poor ED performance were related to poor inpatient flow, access block.
Forster / Canada / 2003[181]	Retrospective data analysis	To identify the effect of hospital occupancy on EDLOS for admitted	351,385 ED visits	EDLOS Rate of daily referral from ED to specialist admitting teams	Acceptable	EDLOS significantly associated with hospital occupancy. No association between hospital occupancy and decision to admit.

		patients and patient disposition				
Kawano / Japan / 2014a[182]	Cross-sectional, single-centre	To assess and model associations between types of ED staff and ED crowding	27,970 ED visits	Proportion of patients with a clinically significant delay EDLOS	Low	No significant negative association between presence of junior residents and clinically significant delay. ***Results of modelling***: Adding 1 junior resident increased EDLOS for all patients. Extra senior resident reduced EDLOS for discharged patients. Extra attending physician reduced EDLOS for all patients.
Kawano / Japan / 2014c[183]	Retrospective data analysis	To estimate the increase in EDLOS with the trend of an ageing society	15,840 ED visits	EDLOS	Acceptable	Increase in older patients vising the ED has a significant negative effect on ED o/c.
Knapman / Canada / 2010[184]	Retrospective, cohort	To assess the impact of aged patients (≥ 65) in the ED on ED crowding, wait times and patient flow for non-emergent patients	223 patients	Wait time to see a physician	Low	Strong relationship between aged patients in the ED and increased wait time for non-emergent patients.
Lucas / USA / 2009[185]	Retrospective, cohort	To determine the effect of hospital census variables on EDLOS	27,325 ED visits	EDLOS Daily ED volume Proportion of ED admissions Daily hospital census Daily census of critical care and cardiac telemetry units Daily number of scheduled surgeries	Low	Significant negative relationship between EDLOS and ICU census, cardiac telemetry census and percentage of ED patients admitted.
Moineddin / Canada / 2011[186]	Data modelling	To assess the factors resulting in increased demand for ED services in a Canadian province	53,353 respondents to a Canadian nationwide survey exploring (among other things) health system utilisation	Number of ED visits in a year	Acceptable	Access to a primary care provider significantly reduces the odds of an ED presentation for low-severity conditions (triage categories 4&5).
^van der Linden / Holland / 2017[101]	Mixed method	To compare staff perceptions of causes of ED crowding in two EDs: one in Pakistan and one in The Netherlands	18 one-hour staff interviews 12 in Pakistan 6 in The Netherlands	Staff perceptions of causes and solutions to ED crowding	Low	Increase in elderly patients and patients with complex conditions. Delays in triaging. Wait time for diagnostic procedures. Delays in decision to admit. Access block.

*Papers also looked at consequences of crowding ^Paper also looked at solutions to crowding
ATS = Australian triage scale CT = computerised tomography ED = emergency department EDLOS= emergency department length of stay GP = general practitioner ICU= =intensive care unit
LAP = low-acuity presentation LWBS = left without being seen o/c = overcrowding/ed

3.3.2 Study quality

The SIGN appraisal tools guidelines[97] recommend that all retrospective or single cohort studies receive a rating of no higher than 'acceptable'. Consequently, the majority of the included studies (59%) were rated as being of acceptable quality. The remaining studies were rated as high (7%) and low (34%) quality. The main area of weakness was inadequate consideration of potential confounders, leading to uncertainty about claims of cause and effect. The level of statistical analysis was often basic, with confidence intervals frequently absent in the reporting of results and few multivariate analyses. Similarly, although percentage and time improvements were frequently noted, often there was no indication whether or not the improvement values were statistically significant. Two survey studies,[110, 111] one focus group study,[112] and two interview studies[101, 105] without confirmatory numerical data, were also included. Furthermore, with the exception of one study,[7] all of the 40 studies that investigated the consequences of crowding reported negative effects. Similarly, all included studies evaluating potential solutions, with two exceptions,[133, 134] reported significant improvements in measures of crowding, leading to questions about the potential for publication bias in this area of research. As regards the solution studies, in many cases it was not possible nor advisable to blind clinicians to the interventions. This makes them vulnerable to the Hawthorne effect, whereby an initiative improves outcomes as participants are aware that their practice is being observed and therefore modify their behaviour. However, for the majority of the interventions in this type of health services improvement research, it could be unethical to undertake a blinded randomised control trial.

3.3.3 Consequences of ED crowding

Forty of the included studies examined the consequences of ED crowding, with three of these being prospective[7, 100, 154] (Table 3.2). Almost all were undertaken in single EDs and reported negative consequences associated with ED crowding. The included studies investigating the consequences of ED crowding can be broadly categorised into patient, staff or system level effects (Table 3.4).

Table 3.4 Studies reporting consequences of ED crowding.

Patient Effects
Poor patient outcomes e.g. for patients with chest pain[110, 111, 148, 163, 176]
Increased mortality[6, 28, 153, 158, 167, 169, 170]
Delayed assessment and care[3, 4, 110, 111, 149-152, 154, 156, 157, 159, 161, 162, 164, 165, 172, 173, including surgery[168]
Increased IPLOS[6, 155, 160, 166, 169]
Risk of readmission[28, 147]
Reduced patient satisfaction[171]
Exposure to error[99, 100]
Staff Effects
Non-adherence to best practice guidelines[3, 4, 100, 148-152, 162, 164, 165, 172, 173]
Increased staff stress[110]
Increased violence towards staff[5, 110]
System Effects
Increased IPLOS[6, 155, 160, 166, 169]
Increased EDLOS[110, 157, 174, 175]

IPLOS = inpatient length of stay EDLOS= emergency department length of stay

Patient

Effects on patients included delays in being assessed and receiving required care,[3, 4, 110, 111, 149-152, 154, 156, 157, 159, 162, 164, 165, 168, 172, 173] increased frequency of exposure to error,[100] including medication errors,[99] reduced patient satisfaction,[171] increased inpatient length of stay (IPLOS)[6, 155, 160, 166, 169] and poorer outcomes[110, 111, 148, 163, 176]; the latter included increased inpatient mortality.[6, 28, 153, 158, 167, 169, 170]

3.3.3 (i) Delayed assessment and treatment

A significant delay in time to balloon inflation for patients experiencing an acute myocardial infarction and transferred to the cardiac catheterisation laboratory (CCL) from the ED during times of crowding, was identified in one American retrospective cohort study.[154] Similarly, delays in undergoing surgery for patients presenting to crowded EDs with a fractured neck of femur, were identified in one Australian study.[168] A number of studies investigated the effects of crowding on time to medication administration in the ED. Findings were predominantly adverse, with crowding associated with delays in time to receive analgesic[3, 152, 159, 164] and antibiotic therapy,[4, 149, 150, 161, 162] as well as delays in patients receiving their usual prescribed or 'home' medications.[156] Two studies reported negative impacts of crowding on timely care

for patients with acute stroke.[165, 172] One study reported significant delays in triage times, with a significant number of patients not assigned any triage score in times of crowding.[173]

3.3.3 (ii) Exposure to error

One American prospective observational study identified an increased frequency of medication errors, including the administration of incorrect and contraindicated medications, during times of crowding.[99] As well as delays in receiving medication, three studies reported an association between crowding and total failure to administer required analgesics or antibiotics.[3, 159, 162] ED crowding was independently associated with increased rates of blood culture contamination in one Taiwanese study, with the rate of contamination strongly correlated with the degree of crowding.[100]

3.3.3 (iii) Increased IPLOS

All of the five studies examining the relationship between ED crowding and IPLOS reported a positive association.[6, 155, 160, 166, 169] One Australian study compared the effect of access block on the IPLOS of 11,906 admitted patients, and reported a mean increased IPLOS of 0.8 days in patients who experienced access block.[166] Richardson's study highlighted that the access block effect on IPLOS was relatively independent of illness severity or diagnosis, but was greatest in patients admitted in the out-of-hours period.[166] Similarly, Sun and colleagues reported a 0.8% increase in IPLOS for patients admitted via an ED which was experiencing crowding, defined by this group as the top quartile of the daily number of ambulance diversion hours.[6]

3.3.3 (iv) Increased inpatient mortality

Although the majority of papers investigating the effects of ED crowding on inpatient mortality reported that as crowding worsened mortality increased, three studies found no relationship.[7, 148, 150] Two of the studies were focussed on specific groups of patients, namely patients presenting with non-ST-segment-elevation myocardial infarction (non-STEMI)[148] and patients with severe sepsis.[150] The third study, undertaken in a tertiary teaching hospital in Belgium, was the only prospective study included in this review that specifically investigated inpatient mortality.[7] Verelst and colleagues measured the outcomes of 32,866 adult patients admitted via the ED over a two-year period. They divided crowding into four quartiles, based on the ratio of the total number of ED patients to the total number of treatment bays, with

quartile four considered as ED crowding. After adjusting for severity of illness they reported no association between ED crowding and risk of inpatient mortality at 10 days.[7]

Conversely, the seven retrospective studies that investigated the effect of ED crowding on inpatient mortality all reported that mortality increased as crowding worsened.[6, 28, 153, 158, 167, 169, 170] The varying results can be partially explained by differences in study designs, making it difficult to compare findings between studies. There were wide-ranging differences in measures of crowding, with daily hours of ambulance diversion,[6] boarding time for admitted patients,[169] mean ED occupancy,[167] EDLOS,[28] and relative ED occupancy[153, 158] variously applied as proxy measures of crowding. Similarly, there were differences in study populations, with most studies including all adult admitted patients.[6, 167, 169, 170] However, one study included only critically ill admitted patients,[153] another included admitted and discharged patients,[158] and another study considered only the outcomes for patients discharged from the ED.[28] However, Verelst et al. justified their finding of no association between ED crowding and increased risk of inpatient mortality as being due to their large sample size, controlling for multiple confounders and their use of a validated measure of crowding, in this case ED occupancy rate.[7]

Staff

Identified negative effects on staff included increased stress,[110] increased exposure to violence,[5, 110] and non-adherence to best practice guidelines during times of ED overcrowding.[3, 4, 100, 148-152, 161, 162, 164, 165, 172, 173] Arguably, the latter could also be positioned with consequences for patients, but here we use it in the context of staff being unable to properly undertake their roles during times of increased crowding.

3.3.3 (v) Increased stress and violence

In a Canadian survey study of 158 ED directors, increased stress among nurses was the most commonly perceived major or serious impact of ED crowding.[110] Staff stress was identified by more participants as an issue than increased wait times or poor patient outcomes. Increased physician stress was also identified as being driven by crowding.[110] A significant association between ED crowding and violence towards staff was reported in one study involving a retrospective chart review.[5] Physical violence was the most frequently documented type, with violence directed towards staff the majority of the time.[5]

3.3.3 (vi) Adherence to guidelines

Poor adherence to approved guidelines was reported to be a consequence of ED crowding in 13 studies.[3, 4, 100, 148-152, 161, 162, 164, 165, 172] Increased time to assessment of pain and/or delays in administration of analgesics were found to be positively associated with ED crowding in all four studies investigating this issue.[3, 151, 152, 164] Similarly, of six studies investigating the effects of crowding on time to antibiotic therapy initiation, five identified a positive association between delayed time to administration and ED crowding.[4, 149, 150, 161, 162] One American study, involving the analysis of data from a voluntary registry tracking guideline adherence, found that patients with non-STEMI who boarded for long periods of time in the ED were less likely to receive guideline-recommended therapies and were at higher risk for repeat MI.[148]

System

System-level consequences identified were those that led to 'bottle-necks' in the system, namely increases in length of stay (LOS), both within the ED itself (EDLOS),[110, 157, 174, 175] and also for those patients admitted to the hospital (IPLOS).[6, 155, 160, 166, 169] Again, these could also be viewed as consequences for patients.

3.3.3 (vii) Increased EDLOS

The three studies that investigated the impact of crowding on EDLOS reported that EDLOS increased with increased crowding. An American, multi-site, retrospective cohort study investigated the effect of crowding on the EDLOS of 226,534 ED presentations at four sites over 12 months.[157] McCarthy and colleagues reported that (i) the number of patients in the waiting room had the greatest impact on time spent in the waiting room, (ii) the number of boarders in the ED was the most consistent factor associated with delays in ED care and (iii) more positively, ED crowding had little effect on time to treatment.[157] While studying only the outcomes in terms of EDLOS of discharged patients, White et al. reported a 10% increase in EDLOS for patients who presented during times of crowding, defined by this group as the top quartile of boarder burden.[174] One Swedish study reported significant increases in median EDLOS for both high and low acuity patients presenting with one of the ten principal medical or surgical complaints during times of crowding.[175]

3.3.3 (viii) Increased IPLOS

As reported under patient effects previously, all of the studies examining the relationship between ED crowding and IPLOS reported a positive association.[6, 155, 160, 166, 169] It should be noted that in the literature this is generally taken to mean that ED crowding leads to increases in IPLOS; however, as is the case with all observational studies, this type of research can only identify an association between EDLOS and IPLOS rather than identifying with any certainty a causative relationship in either direction. For instance, long IPLOS could reduce the availability of beds for patients in ED waiting to be admitted, thereby worsening ED crowding. This limitation is identified in the majority, but not all, of the observational studies included in this review.

3.3.4 Causes of ED crowding

Fourteen included studies investigated potential causes of ED crowding. The majority were retrospective cohort or data analysis studies, with four qualitative explorations,[101, 110-112] and two data modelling studies[182, 186] (Table 3.3). Using the conceptual model of ED crowding developed by Asplin et al.,[8] which divides ED crowding into three interdependent components, the studies that focussed on the causes of crowding can be broadly categorised as identifying input, throughput or output causes (Table 3.5).

Table 3.5 Studies identifying causes of ED crowding.

Input
Presentations with more urgent and complex care needs[101, 110-112, 177]
Increase in presentations by the elderly[101, 112, 183, 184]
High volume of low-acuity presentations[110, 186]
Access to primary care[110, 178, 186]
Limited access to diagnostic services in community[112]
Throughput
ED nursing staff shortages[111, 112]
Presence of junior medical staff in ED[182]
Delays in receiving test results and delayed disposition decisions[101]
Output
Access block[101, 110-112, 179-181]
ICU and cardiac telemetry census[185]

ICU=Intensive Care Unit

Input

Causes of crowding related to the input phase of the ED process suggested increases in types of presentations, including those with urgent and complex needs,[101, 110-112, 177] low-acuity presentations (LAPs),[110, 186] and presentations by the elderly,[101, 112, 183, 184] as the main drivers. Access to appropriate care outside of the ED was identified as an issue in four studies.[110, 112, 178, 186]

3.3.4 (i) Types of presentations

Increased complexity and acuity of patients were perceived to be a cause of ED crowding by 54% of respondents in one American survey study.[110] A similar finding was replicated in an interview study comparing perceived causes of crowding in the Netherlands and Pakistan.[101] Similarly, a 4.6% annual average increase in ED presentations over a six-year period was attributed to increases in presentations of people with urgent and complex care needs, in a population-based longitudinal study in one Australian state.[177] Aboagye-Sarfo and colleagues reported significant increases in presentations allocated Australian Triage Score (ATS) 2 and 3 (high acuity), as well as increases in patients requiring admission, and found that a greater proportion of patients admitted over the six-year period were aged 65 years and older.[177] Increased ED presentations by the elderly, as a factor contributing to crowding was a finding of two Canadian studies, one a retrospective cohort study,[184] and the other exploratory field work involving seven focus groups with key ED staff.[112] Likewise, a Japanese study that undertook a cross-sectional analysis of all adult ED presentations at one ED concluded that older people in the ED had a significant negative impact on ED crowding.[183] Kawano et al. reported that crowding worsened as the mean age of patients in the ED increased.[183]

Conversely, two studies reported that increased presentations by patients with LAPs was a driver of ED crowding.[110, 186] One was the result of survey research with 158 ED directors,[110] whereas the other was the result of statistical modelling undertaken using the results of a large number of surveys exploring Canadian health system utilisation.[186] Moineddin et al. reported that improved access to primary care could significantly reduce the odds of ED presentations for patients with LAPs.[186]

3.3.4 (ii) Access to other forms of care

Poor access to primary care was identified as a cause of ED crowding in four studies.[110, 112, 178, 186] A large UK study that used a cross-sectional, population-based design to investigate whether timely access to GP care led to fewer self-referred ED visits, reported an association. The model developed by this group predicted 10.2% fewer self-referred ED visits for those GP practices ranked in the top quintile for access, with patients able to secure a GP appointment within two days less likely to self-refer to the ED with low acuity conditions.[178] Similarly, a Canadian study concluded that having access to a primary care provider had the potential to reduce non-urgent ED visits (patients allocated triage categories 4 or 5) by 40%.[186]

Throughput

ED nursing staff shortages as a cause of ED crowding was highlighted in exploratory fieldwork undertaken with 158 ED directors in Canada,[112] and in one American study that surveyed 210 ED directors.[111] Adding one junior doctor to a shift increased the EDLOS for discharged patients by one minute, while having no statistically significant effect on EDLOS for admitted patients, in one Japanese study that modelled the effect of additional staff on EDLOS.[182] One interview study that compared the views of ED staff in the Netherlands and Pakistan on causes of crowding identified delays in receiving laboratory test results and delays in patient disposition decisions as issues in both countries.[101] These low quality, predominantly opinion-based studies, were the only included publications to suggest a throughput cause for crowding.

Output

All studies that reported on output factors as a cause of ED crowding concluded that access block, that is, the inability to transfer a patient out of the ED to an inpatient bed once their ED treatment has been completed, was the major contributor.[101, 110-112, 179-181, 185]

3.3.4 (iii) Access block

Two studies analysed both ED and inpatient datasets to understand the relationship between hospital occupancy, access block and ED crowding.[180, 181] The Canadian study reported a significant relationship between ED crowding and hospital occupancy, with a 10% increase in hospital occupancy leading to an 18-minute increase in average EDLOS.[181] The Australian

group found a linear relationship between ED occupancy during periods of hospital access block and total ED occupancy, with a similar relationship noted between access block and ambulance diversion and EDLOS, two other commonly used indicators of crowding.[180] An American multi-site, retrospective cohort study reported a significant positive relationship between mean EDLOS for both intensive care and telemetry bed census, but did not find a significant relationship between ED crowding and total hospital census.[185] Lucas et al. acknowledged that EDLOS is likely to be impacted by total hospital census in times of high occupancy (> 90%) but as the majority of their study was undertaken on days of occupancy < 90%, the study would have been unable to detect this association.[185]

One small Australian study used a novel approach to investigate the effect of access block on crowding. A short period (13 days) of industrial action led to the cancellation of all elective surgery and therefore to significant improvements in bed availability for ED admitted patients.[179] Dunn compared ED performance during the time of increased bed access with a 13-day period prior to and a 13-day period after the industrial action. When there was no elective surgery and an associated reduction in hospital occupancy, there were significant reductions in access block days, EDLOS for patients allocated triage categories 2-5 (ATS 1 excluded from analysis), and patients who did not wait for treatment.[179] Similarly, results of survey research with ED directors,[110, 111] and multi-site, focus group research with key ED staff,[112] highlighted lack of inpatient bed availability as one of the main perceived causes of ED crowding.

3.3.5 Solutions to ED crowding

Fifty-two of the included studies trialled, modelled or suggested potential solutions to ED crowding. The majority were retrospective, with four RCTs,[106-109], one statistical modelling,[139] and four prospective interventional studies[102-104, 118] (Table 3.1). Again, Asplin's[8] conceptual model can be used to categorise the studies that investigated potential solutions to crowding in the ED (Table 3.6).

Table 3.6 Studied and suggested solutions to ED crowding.

Input
GP-led walk-in centres / Co-located GP[9, 113, 139]
Extended GP opening hours[10, 117, 134, 145]
Choice of ED[139]
Social interventions including; education campaigns, financial disincentives, redirection[113]
Throughput
Split ESI 3 on presentation[114]
Earlier physician assessment[11, 14, 102, 104, 118, 126, 140, 144], including physician-led/supported triage[106, 120, 123, 124, 132, 136]
Fast-track / flexible care area[12, 131, 132]
Shorter turnaround-times for laboratory tests[107, 108, 128, 129, 141]
ED nurse flow coordinator[17, 115, 122]
Bedside registration[132, 142]
Nurse initiated protocols[109]
Earlier inpatient consultation[125]
Increased ED bed numbers[17, 133]
Increased ED staff[17]
Output
Active bed management[13, 101, 116, 119]
Leadership program/Support [11, 119, 137]
Implementation of nationally mandated, timed patient disposition targets[11, 16, 17, 130, 135, 138]
ED staff direct admit rights[11, 14]
Admitting team prioritise ED admissions[11]
Alternative admission policies [17, 103, 121, 143, 146]
Increased inpatient beds and staff[17]

GP = general practitioner ESI = Emergency Severity Index

Input

Input factors focused on improved access to other forms of care, such as GP-led walk-in centres (WIC),[9, 113] a co-located GP within or near EDs,[139] extended GP opening hours,[10, 117, 134, 145] or providing a choice of ED.[139] Results of a number of social interventions were trialled over a 12 year period in one study from Singapore.[113]

3.3.5 (i) Co-located GPs and walk-in centres

The effect of a co-located GP on duration of wait for triage category 2 (high acuity) patients in the ED was modelled in one Australian study.[139] Sharma and Inder reported a 19% lower wait time for category 2 patients in EDs with a co-located GP, when compared to EDs without a GP.[139] The impact of a GP-led WIC on demand for ED care was the focus of one UK study.[9] This group used linear modelling to estimate the effect of the WIC on daytime GP-type attendances to other urgent care services in the area. A significant reduction of 8.3% in GP-type presentations to adult EDs was reported.[9] Opening of a WIC in Singapore was found to

have no effect on ED presentations as the authors reported that the WICs attracted their own clientele who were unlikely to have attended the ED.[113]

3.3.5 (ii) Increased GP opening hours

Another UK group evaluated the impact of a pilot 7-day opening of GP practices in central London.[10] Their analysis highlighted a significant, 17.9% reduction in weekend ED attendances by patients registered with practices involved in the pilot program. Dolton and Pathania also reported both a 19% fall in admissions among the elderly and a 29% reduction in elderly cases arriving by ambulance.[10] Similarly, another UK study that investigated the effect of later opening hours and 7-day opening of GP practices reported a 26% relative reduction in patients registered with the intervention practices self-referring to EDs with minor problems.[145] The opening of an after-hours (AH) GP located in a large regional Australian town, serviced by one ED and with limited AH services, resulted in a significant 8.2% daily decrease in total ED presentations of patients allocated ATS 4 and 5 (low acuity).[117] Buckley et al. also reported an unexplained increase in ED presentations of those allocated ATS 1-3 (high acuity), of 1.36 per day, but that the opening of the AH service led to a 'gradual permanent change' in ED presentations.[117]

Conversely, another Australian study that modelled the effect of AHs GPs on LAPs to six EDs in Perth, Western Australia, concluded that providing AHs GP LAP services was unlikely to reduce ED attendance, as LAPs were an 'inexpensive but constant part of ED workload'.[134]

3.3.5 (iii) Social interventions

A study that reported on a number of social intervention trialled in Singapore over a 12-year period reported mixed results. Public education campaigns were found to be effective initially but presentations reverted to pre-campaign levels some months after the end of each campaign.[113] Implementation of financial disincentives for non-emergency presentations began to reduce presentations once the fee exceeded the fees charged by primary health care clinics.[113] Redirection of non-emergencies to alternate facilities was successful initially, but was discontinued due to adverse public relations incidents.[113]

Throughput

The majority of studies (60%) that reported on potential solutions to ED crowding focussed on expediting patients' throughput within the ED. These potential solutions mainly

concentrated on 'front-ending' care earlier in the patient journey by providing earlier physician assessment,[11, 14, 102, 104, 118, 126, 140, 144] including physician-led triage.[106, 120, 123, 124, 136] Dividing patients by level of acuity on arrival has also been successful in increasing throughput times, whether by opening a fast-track or flexible care area for lower acuity presenters,[12, 131] or dividing patients within the same triage code.[114] Other throughput interventions included reducing the turnaround-time of laboratory tests,[107, 108, 128, 129, 141] the introduction of an ED nurse flow coordinator,[17, 115, 122] increasing medical and nursing staff numbers in the ED,[17] bedside registration immediately following triage,[142] nurse initiated protocols,[109] strategies to ensure earlier review by admitting teams,[125] and increasing bed numbers in the ED.[17, 133]

3.3.5 (iv) Early physician assessment

Eight included papers investigated the effects of early physician assessment on measures of ED crowding.[11, 14, 102, 104, 118, 126, 140, 144] Seven of these studies reported significant decreases in EDLOS,[11, 14, 102, 104, 118, 140, 144] whereas four reported significant decreases in numbers of patients who either LWBS or DNW.[11, 104, 118, 144] One Australian group introduced a suite of interventions to improve throughput and output within their large tertiary ED, which had previously been named as the worst preforming ED in Australia in terms of its NEAT '4-hour-rule' compliance.[11] Sullivan et al. also reported significant reductions in inpatient mortality rates between baseline and the post-reform period.

Conversely, when one Dutch urban ED initiated Medical Team Evaluation as a means of improving 'front-end operations' through a host of initiatives, including team triage and a quick registration process, results showed a significant increase in EDLOS for patients in triage categories 2-4, regardless of discharge destination.[126] Lauks and colleagues attributed this rise to the increase in orders for diagnostic radiology during the intervention period.[126]

Five groups investigated the effect of a physician in triage (PIT) model on common ED crowding metrics.[106, 120, 123, 124, 136] Although the interventions were slightly different, all involved a senior physician triaging patients early in their arrival to the ED. All reported a significant reduction in EDLOS post implementation; however, one found this decrease to apply only for patients who were subsequently discharged.[123] Han and colleagues did report an increase in boarding time for admitted patients during the intervention period, a potential reason for the intervention having little effect on EDLOS for admitted patients.[123] Only one study reported a significant decrease in patients who left without being seen,[120] and two

studies reported significant reductions in the number of hours on ambulance bypass during the intervention period.[123, 124] Significant decreases in both 7-day and 30-day mortality post ED visit were also reported by Burström et al. after the introduction of a PIT scheme.[120]

3.3.5 (v) Fast-track and flexible-care areas

Fast-track,[12] or use of a flexible-care area[131] to improve flow within the ED were reported in two papers. Both of these studies reported significant reductions in EDLOS for triage category 4 (low acuity) patients only. As the majority of patients diverted to these areas were triaged as category 4, it is not surprising that the intervention had the greatest effect in this patient group. The fast-track group also reported significant improvements in meeting national standards for wait times for patients triaged as category 4.[12] Similarly, an American group that geographically separated triage category 3 patients with low variability (that is, with conditions likely to follow a standardised work flow), in order to fast-track these patients through the department, reported significant decreases in EDLOS for all category 3 and 4 discharged patients.[114] Arya and colleagues attributed the decreased LOS for higher variability category 3 patients to the decreased throughput of patients through the urgent area of the ED, thereby reducing the workload of staff in this area.[114]

3.3.5 (vi) Reducing laboratory test turnaround-times

Reducing the time taken to turnaround laboratory tests as a means of reducing EDLOS was investigated in four studies. Three studies reported on the use of point-of-care testing (POCT) in the ED versus central laboratory pathology testing,[107, 128, 129] whereas one employed dedicated laboratory technicians within the central laboratory who were available 24/7 to undertake all laboratory testing for the ED.[141] All four studies reported significant reductions in EDLOS attributed to the interventions, although one noted that the reduction in EDLOS was only significant if patients had all three available tests performed.[128] One American group undertook an RCT to assess the impact of earlier initiation of diagnostic tests whilst triage category 3 patients with abdominal pain were in the waiting room.[108] Begaz and colleagues reported a significant 44-minute reduced mean EDLOS for patients randomised to the intervention versus the control arm of the trial.[108]

3.3.5 (vii) ED nurse flow coordinator

The introduction of a senior nurse (emergency journey coordinator), focussed on identifying and resolving delays for patients who had been in the ED for 2-3 hours, led to a 4.9% significant increase in the number of patients meeting NEAT targets in one Australian ED.[115] Similarly, a nurse navigator role trialled as part of a non-RCT reported significant increases in the proportion of patients meeting NEAT time and reductions in mean EDLOS during days when the trial was operational.[122] An NZ group, who investigated the impact of nationally mandated times for patient disposition at four hospitals, reported the introduction of nurse flow coordinators at all four institutions as one of many interventions introduced to successfully reduce crowding.[17]

3.3.5 (viii) Other

Bedside registration immediately following triage, occurring concurrently with physician evaluation, resulted in a significant decrease in time from triage to treatment room allocation for non-urgent patients, in one American before-after intervention study.[142] However, after an initial significant reduction in room-to-disposition time, this improvement was not sustained to 12 months after the intervention.[142] Three of six nurse-initiated protocols were reported to significantly reduce mean EDLOS in one American study.[109] A Korean study that used short text message reminders when ED patients waited more than two and more than four hours for inpatient consultations resulted in a significant 36-minute reduction in median EDLOS for admitted patients.[125] The expansion of the ED from 33 to 53 beds, with no changes to staffing ratios, resulted in a significant 20 hours per day increase in ED boarding in one American study.[133] Conversely, in one NZ study, provision of extra ED beds in three out of the four hospitals studied, as well as the provision of additional ED nursing and medical staff, resulted in a decreased median EDLOS.[17]

Output

Solutions looking at output factors exclusively focused on getting admitted patients out of the ED in a timely manner once their ED assessment and treatment was complete, that is, reducing access block. Suggested and trialled strategies included more active bed management,[13, 101, 116, 119] leadership support to expedite hospital admissions from the ED,[17, 105, 119] including leadership programs,[11, 137] and implementation of nationally mandated timed

disposition targets,[11, 16, 17, 135, 138] which have included; giving ED staff admitting rights,[11, 14] ensuring admitting teams prioritise patients waiting in the ED during times of high ED census,[11] and increasing inpatient bed capacity.[17] Alternative admission units, including an ED-managed, acute care unit,[103] and flexible acute admission units,[17, 127, 143] have also been trialled. Implementation of an independent or full capacity program to provide alternative options for admission in times of crowding has been trialled in two studies.[121, 146]

3.3.5 (ix) Bed management

An active bed management strategy to alleviate ED crowding was evaluated by one American study.[13] The initiative resulted in a 98-minute average reduction in EDLOS for admitted patients, as well as a reduction in the number of hours the hospital was on alert, in this case limiting the types of patients that could be transported by ambulance to the ED.[13] The intervention strategy involved introducing a bed manager who assessed bed availability in real time and who could triage and admit patients to inpatient beds, and a bed director who could call on other resources, including extra staff or admitting medical patients to non-medical beds, to avoid the hospital being put on alert.[13] Similarly, an intervention that included the implementation of a position to ensure timely identification and allocation of beds, coupled with improved communication and education for staff around a new bed management strategy, resulted in a mean 21% decrease in EDLOS for admitted patients, and a 52% reduction in mean boarding time in one American ED.[116] When ED patients were given priority over inpatient beds, as one of a number of quality improvement initiatives to reduce crowding in one American study, there was a significant reduction in median time from bed assignment to disposition and significant reductions in median EDLOS.[119]

3.3.5 (x) Leadership programs and leadership support

One American hospital convened hospital leaders and ED staff to work collaboratively to expedite hospital admissions from the ED.[137] This group introduced a computerised tracking system to ensure the ability for real time tracking of ED admit wait times. The group agreed to measurable goals in terms of the time between the decision to admit and final transfer to an inpatient bed. Patel and colleagues reported a significant 16% increase in patients transferred to an inpatient bed within 60 minutes of the decision to admit.[137] The group also reported significant decreases in boarding time, patients who LWBS and hours of ambulance

diversion.[137] An Australian group also convened a taskforce with senior executive sponsorship to provide oversight and direction for initiatives to improve hospital admission targets.[11] Results of this initiative have been discussed under throughput solutions above and access targets, below. An American study that endeavoured to identify the different strategies used by high-preforming, low-preforming and improving hospitals, in relation to their levels of ED crowding found that no specific interventions were related to performance level.[105] They did, however, report that four organisational domains were associated with high-preforming hospitals, one of which was executive leadership involvement.[105] Tenbensel and colleagues reported that leadership involvement in influencing cultural change was a key factor in implementing hospital-wide initiatives to meet mandated, timed admission targets in NZ.[17]

3.3.5 (xi) Introduction of nationally mandated, timed, patient disposition targets

Six studies have recently reported on the effect of timed patient disposition targets on commonly reported ED crowding measures.[11, 16, 17, 130, 135, 138] One Australian study reported hospital-wide education to increase awareness of NEAT in the six months prior to its implementation as the only intervention.[138] Perera et al. reported a significant increase in the number of patients leaving the ED within the guideline recommended 4-hours, post-NEAT implementation, which was sustained in their second evaluation period, one-year post-implementation.[138] A significant reduction in access block was also reported. However, this group also found a significant increase in IPLOS and in the numbers of inter-unit transfers within 48 hours of admission. They attributed this to the possibility of 'rushed referrals' by ED staff in an effort to meet NEAT targets.[138]

Conversely, Sullivan et al. reported on a plethora of reforms introduced at their large, tertiary referral hospital.[11] These included reforms both within the ED itself, as well as hospital-wide interventions. Many of these initiatives were aimed at reducing access block in the ED, such as: ED staff able to organise direct admission for stable patients, clear limits on response times to ED referrals by inpatient teams, and improved processes for timely discharge of inpatients.[11] As discussed under throughput solutions above, this group reported significant decreases in EDLOS and inpatient mortality.[11] The only negative outcome reported by this group was a small, but statistically significant, increase in re-presentations to the ED within 48 hours, which was seen by the researchers to be clinically insignificant.[11]

Ngo and colleagues reported on a longitudinal analysis of the effect of NEAT on five hospitals in Western Australia, without giving the specifics of interventions introduced at each hospital prior to NEAT implementation.[135] Similar to the above studies, they reported significant reductions in percentage of access block hours in all five hospitals and significant decreases in median EDLOS, primarily for high acuity (ATS 1-3) patients, at three out of the five hospitals.[135] The UK study did not give the specifics of interventions but stated that a whole-system approach was expected to be adopted to achieve the target.[130] Mason et al. reported a 29% reduction in the proportion of patients who remained in the ED after four hours, as well as a 25% reduction in unadjusted median EDLOS for admitted patients.[130]

The NZ studies also reported reductions in median EDLOS post-target implementation.[16, 17] One study reported on the outcomes in relation to when they had the biggest impact and their success in relation to the increased use of short-stay units (SSU).[17] Tenbensel and colleagues found that after an initial reduction in total EDLOS (time in ED plus time in SSU), this reduction slowed in later years, indicating an increased reliance on the use of SSUs to meet target disposition times.[17] Their interview data indicated that transfer to an SSU was sometimes initiated without clinical justification in an effort to meet targets. Nevertheless, they acknowledged that from a patient perspective, time in the SSU is preferable to a longer EDLOS.[17] Jones et al. determined *a priori* quantitative changes that were deemed to be of clinical importance, regardless of statistical significance.[16] They reported clinically significant reductions in median IPLOS, median EDLOS, and access block hours.[16] Although there was no change in 2-day ED representations, they did report a clinically significant 1% increase in 30-day readmissions. Similar to Tenbensel and colleagues,[17] Jones et al. reported an increase in use of SSUs, with < 5% of ED admissions to SSUs in 2009 (pre-implementation) versus almost 13% in 2012.[16] However, the latter study found statistically and clinically significant reductions in total EDLOS, which was greatest for admitted patients, indicating that the SSUs were not merely used to 'stop the clock'.

3.3.5 (xii) Alternative admission policies

One American study explored the impact of a 14-bed monitored inpatient unit, staffed by the ED, on ED crowding.[103] Kelen and colleagues reported significant decreases in both rates of LWBS and hours of ambulance diversion.[103] Similarly, a Taiwanese study reported significant reductions in mean EDLOS for admitted patients after the introduction of a 14-bedded 'high

turnover' unit, specifically used for ED admissions.[127] Utilising empty beds throughout the hospital in the out-of-hours period to accommodate non-specialist admissions to reduce EDLOS and avoid the need for inter-hospital transfers was trialled in one Dutch hospital.[143] The group reported no change in the EDLOS for patients eligible for admission to the new model, at a time when EDLOS for other patients increased significantly.[143] Providing the ED with extra assistance from hospital leaders and specialists during times of crowding in order to expedite patient disposition from the ED has been reported in two studies (capacity protocols).[121, 146] The Korean study, which was investigating the long-term effects of the protocol, as it had been in place for six years, reported significant reductions in EDLOS.[121] Conversely, the American study, which reported on the effect of a relatively new intervention, reported a significant 34-minute increase in EDLOS on days when the full capacity protocol was operational.[146] They also reported a 92% significant decrease in hours of ambulance diversion related to the intervention.[146]

3.4 Discussion

3.4.1 Consequences of ED crowding

A key finding of this review is that the consequences of ED crowding are well established. Reported consequences can be categorised as affecting patients, staff and the healthcare system, with some overlap. Some of the negative effects of crowding identified, such as adverse outcomes for patients, including treatment delays and increased mortality, were similar to those identified in Hoot's review.[1] However, the previous review identified provider losses as a potential negative effect,[1] a finding that was not replicated in the current review. Similarly, Hoot et al. reported impaired access to ED care, as measured by rates of LWBS and ambulance bypass, as potential consequences,[1] whereas both of these measures were used as indicators of crowding in the current study.

The quality of the studies investigating consequences of crowding were variable, with only one high quality, prospective study included.[7] This was also the only study that did not find a link between crowding and the primary outcome measure, in this case increased inpatient mortality.[7] It did appear that the authors of some of the lower quality studies were determined to prove a negative consequence between ED crowding and their outcome of interest. For example, Kulstad and Kelly[154] concluded that crowding decreased the likelihood

of timely treatment for acute myocardial infarction (AMI), when their study showed no relationship between crowding and time to first electrocardiogram or time to arrival in the cardiac catheterisation laboratory (CCL), which are the time stamps that ED staff have most influence over. Their study found a relationship between crowding and time to balloon inflation in the CCL, a delay that is presumably outside of the control of the ED.[154]

Similarly, Hwang and colleagues[151] concluded that crowding is significantly associated with poorer pain management. Their study identified a negative association between crowding and time to assessment and documentation of pain, but no relationship to time to analgesic administration, that is, the outcome that affects patient care.[151] Rather than identifying negative outcomes for patients who present to crowded EDs, both of these studies could be taken to show the opposite. That is, that even when the ED is under stress, patients identified as having urgent clinical needs, such as those suffering from an AMI or being in severe pain, still receive appropriate, timely care. We acknowledge that the complexity of health services research provides challenges in terms of research design, often influencing investigators decisions to measure outcomes for which data is easily accessible. However, care needs to be taken when designing studies and interpreting results to ensure reported outcomes are robust and reflect the most appropriate measure of the phenomena under study.

3.4.2 Solutions to ED crowding

Trialled and modelled solutions to ED crowding included providing alternative options to the ED for patient care, moving patients through the ED more quickly and expediting patients' exit from the ED on completion of care. Many of these solutions were identified in the previous review,[1] particularly the solutions aimed at resolving access block and providing alternative admission options. However, Hoot's review identified many demand management strategies, including diverting patients to other forms of care and focussing on frequent visitors, which was the focus of only one, older study included in this review.[113] The demand management and patient diversion papers in the earlier review were all published more than twelve years ago, perhaps indicating the lack of long-term success of these initiatives at reducing ED crowding.

All studies included in this review evaluating solutions, with two exceptions[133, 134] reported significant improvements in measures of crowding related to the intervention, whether trialled or modelled. It should be noted that in Nagree's study,[134] that concluded that AHs GPs

would have little impact on LAPs to EDs, the Sprivulis method[187] was used to calculate LAPs. This method consistently estimates a lower proportion of presentations as 'GP-type' than other methods.[188, 189] One Australian group reported a range of 15-69% of ED attendees as 'GP-type', depending on which of four definitions were used to calculate the proportion,[188] with the Sprivulis method[187] producing the lowest percentage. Another Australian group[117] speculated that their finding of reduced LAPs to the ED following the opening of an AHs GP differed from Nagree's findings because of the relative rural nature and therefore lack of alternative options in the study locality, compared to the urban area studied by Nagree.[134] This finding is a clear indicator that a 'one size fits all' model to alleviate crowding is unlikely to be successful, as the causes of crowding are contextually specific to the environment in which the crowding occurs, and therefore require solutions explicitly designed for that environment. The above also highlights the difficulties in comparing research outcomes when non-standardised definitions are employed as study outcome measures. This issue has been highlighted before,[94, 95] with calls for a consensus on definitions for crowding, 'GP-type' presentations and LAPs to enable more accurate measuring and reporting of these issues.

3.4.3 Quality of solutions studies

The quality of the evidence evaluating solutions to ED crowding was higher than for the other two areas (causes and consequences) with 60% of the studies assessed as providing high or acceptable levels of evidence. Many input, throughput and output solutions, including WICs, providing earlier physician assessment on arrival to the ED, and providing alternative admission options during times of inpatient access block, have been found to have promising results. Although POCT was trialled in five included studies, only two of these, both RCTs,[107, 108] were assessed as providing high levels of evidence, suggesting more research needs to be undertaken in this area.

Whereas the majority of the included papers, particularly those that looked at throughput initiatives, did not measure unintended 'upstream' effects of the interventions to reduce crowding, a number of the more recent 'target' papers did.[11, 16, 130, 138] The Australian papers reported increased in-hospital transfers, increased IPLOS,[138] and a small clinically insignificant increase in ED representations within 48 hrs[11] as potentially negative clinical outcomes post-NEAT implementation. One NZ study reported a clinically important 1% increase in readmissions within 30 days.[16] The UK study found an unexpected increase in time to be seen

by a clinician and reported that when EDLOS was adjusted for clustering by hospital, there was an increase in total time in the ED for admitted patients.[130] Overall, the 'target' studies provided acceptable levels of evidence of both improved processes and patient outcomes following their introduction, indicating that more research into the specific interventions undertaken to achieve targets, with an emphasis on understanding what worked, where and why, could go some way towards addressing ED crowding. Similarly, more recent studies have highlighted the positive effects of undertaking a whole-of-system approach, including involvement of system leaders and using available data for more effective communication as important strategies to reduce crowding.[11, 17, 105]

Although one of the NZ 'target' studies[17] acknowledged some input strategies were implemented in at least one of their test sites, in the main 'target' studies focussed their reporting on throughput and output initiatives to address crowding. The two UK studies that reported reduced ED presentations following 7-day opening of GPs,[10, 145] as well as the successes achieved after the opening of an AH GP clinic in a large regional centre,[117] provide evidence to support further trials of increased access to primary care as a potential solution to crowding in areas where increased input has been identified as a causative factor.

3.4.4 Costs of solutions

A number of studies identified financial costs associated with the interventions,[10, 17, 115, 129, 145] but did not provide any cost benefit analysis. One exception is an Australian study that calculated a $2,121 AUD per day saving to the ED after the introduction of a nurse navigator role.[122] Similarly, although not providing a comprehensive cost benefit analysis, Nagree et al. estimated that LAPs accounted for only 2.5% of total ED costs in the Perth metropolitan area, and therefore AH GPs were not a worthwhile investment if their aim was to reduce LAPs to the ED in a metropolitan setting.[134] Whittaker et al. acknowledged that although extended GP opening hours was seen to reduce patient-initiated ED referrals, extended opening hours may not produce a cost saving to the healthcare system.[145]

3.4.5 Causes of ED crowding

Surprisingly, the least number of studies included in this review investigated the causes of ED crowding. Causes included increases in types of ED presentations, limited access to primary care, and access block for patients requiring admission. Access block, inadequate staffing, and

LAPs were also identified in Hoot's[1] review as causes of crowding. However, a notable new identified cause in this review is the increase in presentations by patients with complex and chronic conditions, including the elderly, as a driver of ED crowding.[110, 177, 183, 184] This finding may indicate the emergence of a new driver of crowding, namely the elderly with multiple chronic conditions, and merits further investigation. The quality of the evidence investigating causes was mixed, with only seven (50%) studies assessed as being of acceptable quality, whilst the remainder were scored as low. Three of the higher quality studies identified access block as having a negative impact on ED crowding; however, all of these studies are more than ten years old.[179-181] The remaining four studies identified increased presentations by patients with chronic and complex care needs, including the elderly, and limited access to GPs, as causative factors of crowding,[177, 178, 183, 186] adding further weight to the suggestion that increasing access to primary care may help to reduce crowding.

Fifteen years ago, Asplin[8] proposed in his conceptual model that ED crowding could be partitioned into three interdependent components, input, throughput and output. Of the 14 studies that investigated the causes of ED crowding, only four identified a throughput issue, namely experience level of staff,[182] shortages of staff within the ED,[111, 112] and delays in test results and disposition decisions,[101] as potential causative factors. However, of the 52 papers that trialled or modelled potential solutions to crowding, 31 (60%) involved improving patient throughput as a means of resolving the issue, with none of the interventions specifically targeted at improving staffing issues. This suggests a mismatch between the proven or accepted causes of crowding and the solutions developed and implemented to address the problem. There is general agreement that many of the causes, and therefore solutions to crowding lie outside of the ED. However, our findings suggest that, as the most immediate effects of crowding are visible in the ED, ED clinicians have perhaps taken it upon themselves to change what they can influence to try to ameliorate the problem.

This review identified many new studies focussed on the ED crowding agenda. However, there is a paucity of research aimed at identifying the specific, contextual factors causing the phenomenon, with only eight new studies aimed at identifying causes published in the last ten years. The imbalance between the vast number of studies investigating the consequences and trialling solutions to ED crowding, versus the scarcity of studies aimed at identifying the causes, warrants attention. As stated by Asplin et al., 'the development of valid and reliable measures of the factors **contributing** to ED crowding is the **first step** in developing a coherent

research and policy agenda'.[8] It appears that 15 years after this recommendation, the ED research community is yet to thoroughly address that 'first step'.

3.4.6 Limitations

The literature search was limited to research published in English and in peer-reviewed journals. Potentially, a wider search strategy may have located a greater number of relevant studies; however, with the number of studies appraised and included, we feel this review provides a comprehensive analysis of the current research on ED crowding. Only seven of the included studies were assessed as being of high quality. This is an issue that has been highlighted before, with authors also acknowledging that it is difficult to critique complex and multi-faceted health service research using evaluation criteria designed for drug trials.[190] However, we elected to assess the quality of the evidence using traditionally accepted methods to enable the comparability of our results with previously published reviews. When allocating causes and solutions studies as related to either input, throughput or output, every effort was made to follow the original intentions of the study authors; however, this intention was not always clear.

3.5 Conclusion

There is an abundance of research illustrating the negative consequences of ED crowding for patients, staff and the healthcare system. Although many solutions have been trialled and modelled, with varying levels of success, there is a mismatch between the identified causes of crowding and the initiatives implemented in efforts to resolve the problem. More recent studies investigating the effects of timed disposition targets and extending GP opening hours have provided some promising results and warrant further investigation and evaluation, with a particular focus on which interventions worked in which contexts, relative to identified local causes of crowding. A significant finding of this review is the growing body of evidence suggesting elderly patients with complex, multi-morbid conditions represent an increasingly important driver of ED crowding. This review has highlighted the need for further, high quality research into the specific, contextual issues that lead to ED crowding and the tailoring of evidence-based solutions to address identified causes. There is agreement that the problem and therefore the solutions to ED crowding lie largely outside of the ED. Therefore, it is

imperative that the whole of the system, including patients, are involved in identifying both the causes of and acceptable, sustainable solutions to ED crowding.

3.6 Chapter Summary

This comprehensive systematic review of the international literature found that, from 102 included studies, the negative consequences of ED crowding for patients, staff and the healthcare system are well established. However, there was a scarcity of research identifying the specific causes of ED crowding. As the causes of crowding are likely to be contextually specific to the environment in which the crowding takes place, it is essential that local drivers are identified, to enable the designing of appropriate, sustainable solutions. Tasmania has been identified as having all the 'key elements' that make it more likely a person will attend the ED, and ED crowding has been identified as being a major issue in the THS. Consequently, this research project aimed to examine temporal and regional patterns in hospital ED presentations in Tasmania, and subsequently investigate the factors driving ED usage. The following chapter of this thesis will detail the analysis of four-years of ED presentations in Tasmania, with the aim of identifying longitudinal patterns of ED presentations across the state, as well as isolating any regional variations in ED usage.

Chapter 4. Characteristics of longitudinal patterns of emergency department presentations in Tasmania

"It is a capital mistake to theorise before one has data"
— Sir Arthur Conan Doyle

This chapter was published as an original research article in the peer-reviewed journal, *International Emergency Nursing* in September 2017. The final Word version of the completed manuscript in included here, with references listed at the end of this thesis. A PDF of the published manuscript is included in the appendices (appendix (v)).

Planning for the future: emergency department presentation patterns in Tasmania, Australia

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Abstract

Background: Emergency department crowding and associated adverse outcomes are major issues in healthcare systems worldwide. The Australian government has highlighted the need to analyse emergency presentations to inform system redesign.

Objective: To describe the profile of emergency department presentations by Tasmanian residents to emergency departments over four years and examine regional variations.

Method: A retrospective analysis of emergency department data for Tasmania's public hospitals over four financial years, 2010-11 to 2013-14, was undertaken. Descriptive statistics were used to identify patterns in Tasmanian state-wide emergency presentations, as well as disparities between Tasmania's three regions (South, North and North-West). Regression analysis was undertaken to test if changes were significant.

Results: State-wide presentations increased by 3.4% (139,352 to 144,130) over the four years. Regional variations included an increase in presentations of 16% in the South, 5.1% in the North and a decrease of 3.9% in the North-West. Per capita presentations were consistently lowest in the South and highest in the North-West. The South recorded a significant increase in per capita presentations of those aged 75 and over ($p = 0.001$), increasing at a rate of 12.5 per 1,000 residents per annum (95% CI 5.8 – 19.2).

Conclusion: There is regional variation in emergency demand and utilisation in Tasmania. The results indicate that recent increases are predominantly occurring in the South, including in the elderly, and the reasons for this warrant further investigation.

Key Words: *emergency services, hospital; demand; health-seeking behaviour; decision making; crowding*

4.1 Introduction

Increased presentations to Emergency Departments (EDs) contributing to crowding, and its associated adverse outcomes, are major issues in Australia and around the world.[191, 192] Unfavourable outcomes of ED crowding include prolonged length of stay in ED for both high and low acuity presentations,[157] and increased inpatient mortality.[6, 167, 170] Australia experienced a 21% increase in demand for care at public hospital EDs over the five financial years to 2013-14.[193] The increase in ED presentations is not simply explained by the national population growth rate and ageing of the population.[35]

Research investigating the probability of an individual's attendance at an ED has highlighted particular groups whom are more likely to attend. In Australia, those living in outer regional, remote and very remote areas, as well as those living in lower socioeconomic areas, are more likely to visit an ED than those living in major cities and areas of higher socioeconomic advantage.[194] Older Australians have also been highlighted as being over represented in EDs.[194]

These drivers of ED utilisation are particularly relevant in Tasmania where all of the state is classified as either regional or remote.[48] In 2013-14, 34% of Tasmanians were classified as residing in either outer regional, remote or very remote areas, compared to 11% for Australia as a whole.[48] In addition, 32.9% of Tasmanians live in the most disadvantaged quartile of the Socio-Economic Indexes for Areas (SEIFA) index.[47] Of all Australian states and territories, Tasmania has the highest proportion of people aged over 65 years, accounting for 16.8% of the state's population in 2014.[47] In Australia, both the Commonwealth and Tasmanian governments have highlighted the importance of identifying and analysing sources of ED presentations as a major priority.[34, 193]

The aim of this study was to describe the profile of presentations to Tasmanian EDs, including regional variations, over four financial years, 2010-11 to 2013-14. The data would provide information regarding demographics of ED users, acuity and time of presentations, mode of arrival, and discharge destination.

4.2 Methods

4.2.1 Study setting

Tasmania is Australia's most Southerly and only Island state with a population of 514,800 (2014).[48] Between July 2012 and July 2015 Tasmania's acute healthcare system operated as three separate Tasmanian Healthcare Organisations (THOs). These THOs were serviced by four public hospital EDs; Launceston General Hospital (LGH) in THO North, North West Regional Hospital (NWRH) and Mersey Community Hospital (MCH) in THO North-West and Royal Hobart Hospital (RHH) in THO South. Each hospital offers 24-hour a day ED services.

4.2.2 Study design

A retrospective analysis of ED presentations to Tasmania's public hospitals over four financial years (2010-11 to 2013-14) was undertaken. The study was approved by the Tasmania Human Research Ethics Committee (application number H13948) (Appendix (vi)).

Data for all patients attending the four public hospital EDs in Tasmania were provided by the Tasmanian State Department of Health and Human Services (DHHS). The DHHS data contains de-identified demographic, administrative and clinical information pertaining to all ED presentations.

In Australia, the Statistical Area-level 2 (SA2) code is the base spatial unit used to collect statistics. Collectively the SA2s cover the whole of Australia without gaps or overlaps (average population 10,000).[195] Patients' places of residence were assigned to one of Tasmania's three regions, South, North or North-West (NW) using SA2 codes. This excluded presentations to Tasmanian EDs by non-Tasmanians, indicating only patterns of ED usage by Tasmanians. Similarly, in sub-group analyses of presentations in a particular region, only residents of that region were counted.

All patients who present to an ED in Australia are assigned one of five possible categories of the Australian Triage Scale (ATS).[196] ATS 1 represents the most urgent or highest acuity group with ATS 5 representing the least urgent or lowest acuity group. For ease of comparison in this study, triage categories were grouped into ATS 4 and 5 (low acuity presentations (LAPs)) and ATS 1-3 (high acuity presentations).

Data were coded to identify patients who attended the ED in the out-of-hours period. Using a definition applied by Primary Health Tasmania (PHT),[197] out-of-hours included before 8am and after 6pm on Monday to Friday, before 8am and after 12pm on Saturday, and all day on Sunday and public holidays.

4.2.3 Data analysis

Data were obtained for four financial years, July 1st 2011 to June 30th 2014 inclusive. Descriptive statistics were used to compare changes in mode of arrival to the ED, urgency of presentation, in-hours versus out-of-hours attendance and discharge destination. Linear interpolation was applied to annual population estimates obtained from the Australian Bureau of Statistics (ABS)[198] to estimate quarterly populations. These figures were used to calculate per capita presentations for the state as a whole and for each of the three regions by five-year age bands. Linear regression analyses were undertaken to test whether changes in per capita presentations were statistically significant ($p < 0.05$). Data were analysed using R version 3.1.2 and Microsoft Office Excel 2013.

4.3 Results

4.3.1 Absolute numbers of presentations to Tasmanian EDs by Tasmanians

The data set initially comprised 580,456 presentations. After excluding presentations by non-Tasmanians, the final data set number was 563,649 (2.9% excluded). Presentations to Tasmanian EDs increased from 139,352 to 144,130 (3.4%) from the first year of the study period (2010–11) to the last (2013–14). Over this time, the number of patients presenting to the ED who were subsequently admitted to hospital increased by 23% (29,887 to 36,807), whilst ambulance arrivals increased by 11.5% (34,689 to 38,672). In the four years, high acuity presentations increased by 6.8% (57,558 to 61,490) whereas LAPs increased by 1% (81,403 to 82,242). Presentations in the out-of-hours period remained relatively stable, with 54% of all presentations occurring during this time in the both the first and last years of the study (data not shown).

4.3.2 Regional patterns

When the data were disaggregated into regions, different patterns emerged (Table 4.1). Presentations in the South increased each year of the study and recorded a 16% increase over the four-year period, with increases observed across all five-year age bands. Presentations in the North decreased in the second year (2011-12) but recorded an overall increase of 5.1% between the first and final years. Changes in the North-West varied over the study period, and the region recorded an overall decrease in presentations of 3.9%.

The South recorded increases across all levels of acuity with the greatest increase (25%) for LAPs. The North recorded increases of 5% across both high and LAPs, and the North-West recorded an increase in high-acuity presentations (14%) and a comparative decrease in LAPs (-14%). Whilst all regions recorded an increase in ambulance presentations, particularly in the South (20%), the proportion of ED patients arriving by ambulance varied greatly between regions: 35% in the South, 25% in the North and 20% in the North-West in 2013-14.

Thirty-three per cent of all presenters in the South in 2013-14 were subsequently admitted, an increase of 24% over the study period. The proportion of presentations resulting in admission in the North and the North-West equated to approximately one-fifth of all attenders, with increases over the period of 26% and 28%, respectively (Table 4.1).

Table 4.1 Comparison of regional Tasmanian ED usage by residents of each region: 2010-11 to 2013-14.

	South (%)			North (%)			North-West (%)		
	2010-11	**2013-14**	**% Change**	**2010-11**	**2013-14**	**% Change**	**2010-11**	**2013-14**	**% Change**
Population	252 805	256 338	1.4	143 369	143 695	0.2	113 990	113 897	-0.1
Total number of Presentations	42 712	49 539	16	39 302	41 306	5.1	48 917	47 026	-3.9
ARRIVAL MODE									
Emergency Amb.	14 275 (33)	17 113 (35)	20	9 345 (24)	10 226 (25)	9.4	8 687 (18)	9 208 (20)	6.0
"Walk-ins"	27 202 (64)	31 306 (63)	15	29 636 (75)	30 652 (74)	3.4	39 931 (82)	37 380 (79)	-6.4
TIME OF DAY									
In Hours	17 866 (42)	20 947 (42)	17	17 332 (44)	18 243 (44)	5.3	23 035 (47)	21 618 (46)	-6.1
Out-of-Hours	24 846 (58)	28 591 (58)	15	21 970 (56)	23 063 (56)	4.9	25 882 (53)	25 408 (54)	-1.8
AUSTRALIAN TRIAGE SCALE									
1	309 (0.7)	366 (0.7)	18	122 (0.3)	130 (0.3)	6.6	131 (0.3)	169 (0.4)	29
2	3 915 (9)	4 820 (10)	23	2 688 (7)	2 788 (7)	3.7	2 674 (5)	3 756 (8)	40
3	16 385 (38)	16 819 (34)	2.6	13 453 (34)	14 221 (34)	5.7	14 316 (29)	15 659 (33)	9.4
4	16 605 (39)	20 236 (41)	22	21 454 (55)	20 890 (51)	-2.6	25 442 (52)	23 787 (51)	-6.5
5	5 316 (12)	7 106 (14)	34	1 475 (4)	3 175 (8)	115	6 352 (13)	3 647 (8)	43
ATS 1-3	20 609 (48)	22 005 (44)	6.8	16 263 (41)	17 139 (41)	5.4	17 131 (35)	19584 (42)	14
ATS 4 & 5	21 921 (51)	27 342 (55)	25	22 929 (58)	24 065 (58)	5.0	31 494 (65)	27 434 (58)	-14
ED DISCHARGE DESTINATION									
***Non-admitted**	29 317 (69)	32 980 (67)	12	32 583 (83)	32 827 (79)	0.7	41 412 (85)	37 390 (79)	-10
[#]Admitted	13 395 (31)	16 559 (33)	24	6 719 (17)	8 479 (21)	26	7 505 (15)	9 636 (20)	28

*Departed without being admitted, dead on arrival, did not wait, left at own risk. [#]Admitted, referred to another hospital for admission, died in ED

4.3.3 Per capita presentations

When examining per capita presentations, different patterns emerged for each region (Fig. 4.1). Although absolute numbers of presentations in the North-West fell over the time period, this region consistently saw greater per capita presentations across all age groups than the other two regions. Residents in the North consistently presented at a greater rate than residents in the South.

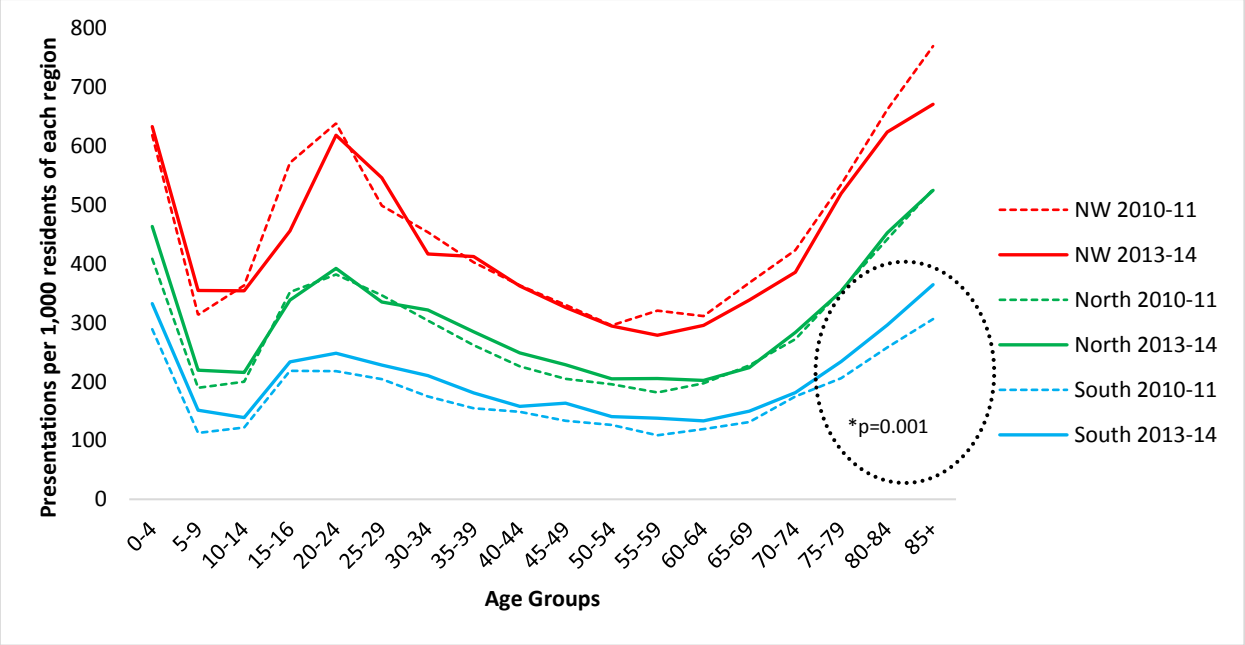

Figure 4.1 Per capita presentations to Tasmanian EDs by residents of each region: 2010-11 to 2013-14
* Significant increase in per capita presentations of those aged ≥ 75 years in the South (p = 0.001)

4.3.4 Acuity of presentations

When comparing per capita presentations by level of acuity (Figs 4.2 and 4.3) there was further evidence of regional variation. LAPs in the South increased across all age groups (Fig. 4.2a), with significant increases seen in all age-bands under 60 years ($p < 0.005$). LAPs in those aged under 60 years in the South increased at a rate of 9.9 per 1,000 residents per annum (95% CI 7.1 – 12.7). Conversely, there was a statistically significant decrease in LAPs across the majority of age bands in the North-West (Fig. 4.2c). High-urgency presentations in the North-West increased at a significant rate in almost all age groups between ages 10 to 54 years (Fig. 4.3c). The South recorded increases in high-

urgency presentations in some of the older age bands (Fig. 4.3a). The North recorded increases of 5.4% and 5% in high (Fig. 4.2b) and low (Fig. 4.3b) acuity presentations respectively.

4.3.5 Increased presentations in the South

Total presentations in the South increased across all age bands; however, presentations of those aged 75 and over increased at a significant rate ($p = 0.001$) (Fig. 4.1). Regression analysis of per capita presentations versus time found that presentations of those aged 75 and over in the South, between 2010-11 and 2013-14, increased at a rate of 12.5 per 1,000 residents per year (95% CI 5.8 – 19.2).

In 2013-14, 68% of presenters to the RHH aged 75 and over were admitted, versus 29% of those aged less than 75 (OR 5.2, 95% CI 4.9-5.5) (Table 4.2). The higher proportion of admissions in the older age group was consistent each year of the study. Similarly, the mean length of stay for those age 75 and over was consistently longer than for younger presenters. This remained the case regardless of the outcome of the presentation (Table 4.2). In 2013-14 patients aged 75 years and older spent over 36,000 hours in the RHH ED (data not shown)

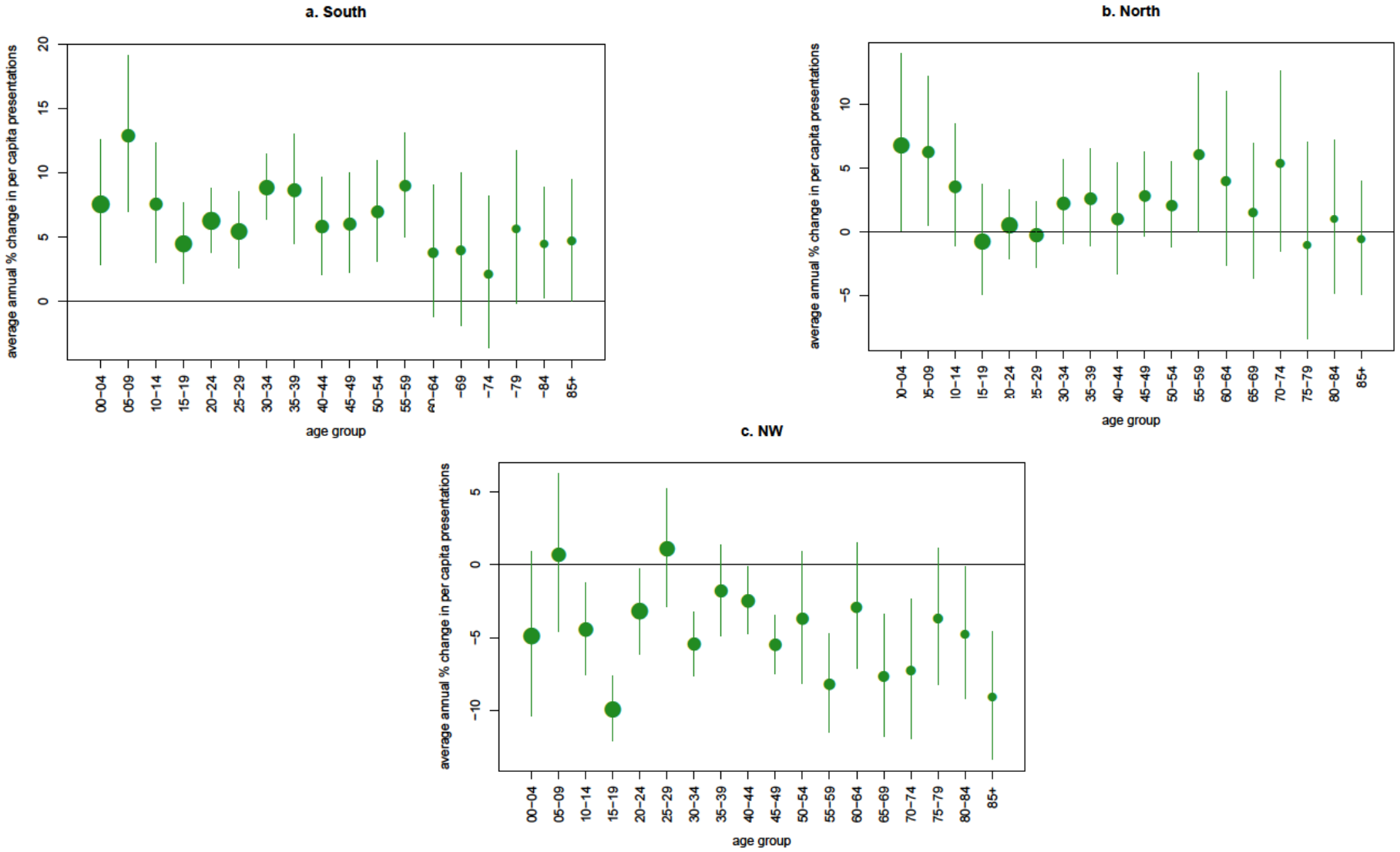

Figure 4.2 Annual average percentage change in per capita presentations of #***low acuity*** patients to Tasmanian EDs, 2010-11 to 2013-14: a. South, b. North, c. NW

#Australian Triage Categories 4 & 5 combined. The size of the dots denotes the actual numbers of presenters in each age group in 2013-14

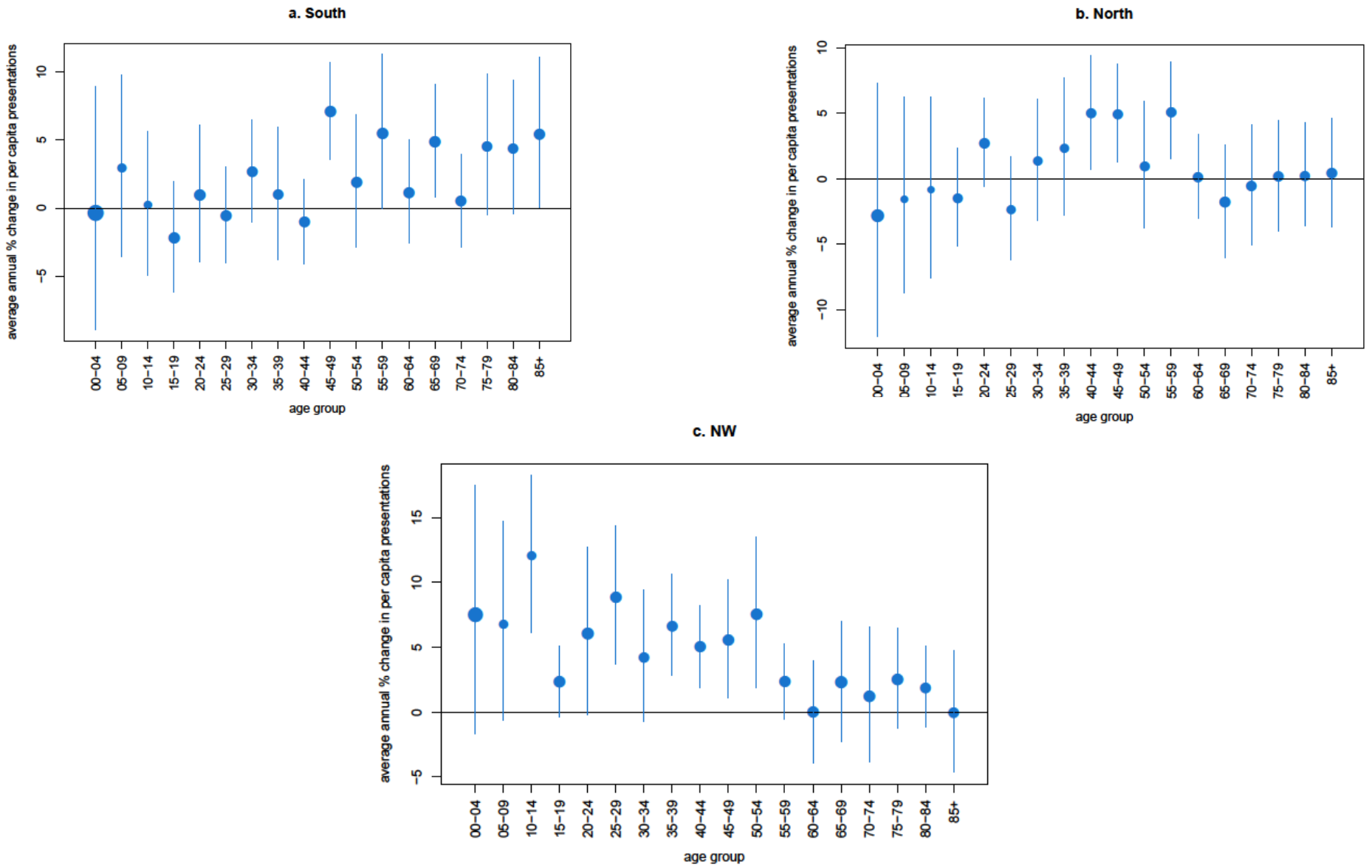

Figure 4.3 Annual average percentage change in per capita presentations of #***high acuity*** patients to Tasmanian EDs, 2010-11 to 2013-14: a. South, b. North, c. NW

#Australian Triage Categories 1, 2 & 3 combined. The size of the dots denotes the actual numbers of presenters in each age group in 2013-14

Table 4.2 Comparison of #LOS in the South between patients aged <75 years and patients aged ≥75 years.

	< 75				≥ 75				
	Mean LOS Admitted	**Mean LOS Discharged**	**Mean LOS**	**% admitted**	**Mean LOS Admitted**	**Mean LOS Discharged**	**Mean LOS**	**% admitted**	**Odds of admission (95% CI)**
2010-11	9.7hrs (585mins)	3.7hrs (221mins)	5.3hrs (320mins)	27	11.2hrs (673mins)	5.0hrs (301mins)	9.2hrs (553mins)	68	5.6 (5.3-6.0)
2011-12	7.3hrs (440mins)	3.3hrs (196mins)	4.3hrs (260mins)	26	8.1hrs (488mins)	4.8hrs (289mins)	7.0hrs (418mins)	65	5.2 (4.9-5.6)
2012-13	8.0hrs (481mins)	3.1hrs (187mins)	4.3hrs (261mins)	25	9.3hrs (558mins)	4.2hrs (252mins)	7.4hrs (446mins)	63	5.2 (4.8-5.5)
2013-14	7.1hrs (426mins)	2.9hrs (176mins)	4.1hrs (249mins)	29	8.9hrs (532mins)	3.7hrs (224mins)	7.2hrs (434mins)	68	5.2 (4.9-5.5)

#Length of Stay

4.4 Discussion

The main finding of this study was the widespread variation in ED usage between Tasmania's three regions. This result can be further divided into three main points. Firstly, residents in the state's North-West present to the ED at a much greater per capita rate than the other two regions, and at a rate greater than the national average.[193] Secondly, in terms of increased presentations, the majority of the increases were in the South of the state. Finally, although presentations in the South of the state increased across all five-year age-bands, there was a significant increase in presentations of those age 75 years and older, across all triage categories.

When considering state-wide ED presentations in the four years under study, there were sizable increases in the proportion of patients arriving by ambulance, presenting with high acuity conditions and being subsequently admitted to hospital. This finding in itself depicts a significant threat to existing ED resources.

4.4.1 Per capita presentations in the North-West

Residents of the state's North-West presented to ED at a per capita rate of up to 2.5 times that of the South. This large disparity in regional per capita presentations has continued, even allowing for the overall drop in presentations in the North-West. North-West Tasmania is the most rural part of the State, and this is a potential explanation for the high per capita rates of presentation in this region. Callen and colleagues, who undertook a survey of attendees at a rural Australian hospital, highlighted patients' perspectives that rural EDs are an important alternative to primary care, particularly in the after-hours period.[199] Similarly, a previous study undertaken by Cheek and colleagues in NW Tasmania concluded that providing low-acuity care in parallel with more acute services may be the best service model to meet the needs of rural communities.[200] Cheek's suggestion may have been related to the reduced availability of GPs in this rural area. The most recent GP census in Tasmania showed that the North-West had the highest number of patients per full time equivalent GP in the state (1,389 people), which was also higher than the national average (1,214 people).[201]

The high per capita ED presentations in this region has been reported before,[188] with researchers speculating that the EDs in North-West Tasmania 'act as GP super-clinics'. However, here we present a new finding, that there has been a recent decrease of 14% in

LAPs in this region, whilst high acuity presentations have increased by 14% with a corresponding increase in admissions. This finding suggests that rather than using the EDs as GP clinics, residents of the North-West are changing how they utilise the service and are starting to reserve presentations to the ED for more serious conditions. An investigation into what has led to this change in healthcare-utilisation behaviour is warranted. Future research could involve an exploration of changes in local health care service provision as it is possible that changes in access to alternative forms of health care have led to the recent reduction of LAPs to the EDs in this region.

4.4.2 Increases in the South

Another regional variation identified is the increase in presentations in the South of the state compared to a decrease in the North-West and a modest increase in the North. The increase in the South equated to an annual average increase of 5.1%, greater than that reported by other Australian regions.[90, 177] This increase was not explained by population growth, as the population of this region increased by only 1.4% over the four-year period.[198] The majority of the increase was in LAPs (25%). In fact, the majority of the increased presentations by those aged 60 years and under can be attributed to increases in LAPs by patients in this demographic (Fig. 4.2a).

Interestingly, Dinh and colleagues, who conducted a recent retrospective analysis of ED presentations in New South Wales, covering the five years 2010-2014, reported no increase in LAPs.[202] These researchers used a different definition of low acuity, that is, a definition used by the Australian government for potentially avoidable 'GP-type' presentations. As well as including patients allocated triage categories 4 or 5, it also included patients who were self-referred and who were subsequently discharged to their usual place of residence. However, when our data were reanalysed using this alternative definition, we still found a 21% increase in LAPs in the South of Tasmania. It is possible the discrepancy lies in the number of LAPs referred by their GP to the ED in the South, as a recent investigation into LAPs in the North of Tasmania reported almost 29% of LAPs had been told to go to the ED by a doctor or a nurse.[203] Unfortunately, identifying self-referred LAPs was outside the scope of this analysis. It is worth noting that the Australian government has recently ceased reporting figures for potentially avoidable 'GP-type' presentations, due to the limitations of the definition.[193]

Although increased LAPs to the ED may not directly lead to overcrowding, studies have reported reductions in wait time and length of stay in ED for higher acuity patients by diverting LAPs away from the ED,[139] or steaming their care within the ED.[104] Therefore, it is worthwhile trying to understand the reasons patients attend the ED for non-urgent conditions. In a survey of Australian patients who attended EDs during 2013-14, 22% of respondents felt the required care could have been provided by a GP.[194] Unavailability of their GP was the reason given by 23% of these attendees, whereas 3% believed that the waiting time to see a GP was too long.[194] The proportion of Tasmanian respondents who reported that their GP was unavailable (15.9%) was the lowest in the country.[204] However, in 2012-13 GP type presentations (according to one definition) in Tasmania accounted for 41.9% of all ED presentations, which was substantially above the national average of 32.4%.[34]

The drivers behind LAPs to the ED have been investigated in multiple studies that have reported similar contributing factors.[191, 203, 205] Although different methodologies were used in these studies, including interviews[191, 205] and surveys,[203] all studies identified barriers in accessing primary care and patient perceived urgency of care as factors associated with the decision to attend the ED. Unwin and colleagues[203] concluded that providing more accessible and appropriate services could lead to a reduction in LAPs to the ED. It is feasible that providing increased access to alternative forms of care, coupled with patient education on appropriate use of services could reduce LAPs in the South. However, to identify the strategies most likely to succeed it is important to understand the specific contextual factors that have led to this sustained increase.

Therefore, future research should focus on an investigation of the specific factors that contribute to residents of Tasmanian deciding to seek treatment at the ED for low acuity conditions. It is essential that the opinions and motivations of local presenters are sought, as only they can identify the decision-making processes behind their attendance at the ED, and consequently may provide insights into acceptable alternatives to ED for their specific health care needs.

4.4.3 Presentations by the elderly

When looking at total presentations in the South, there was a significant increase in per capita presentations of people aged 75 and over (Fig. 4.1). Presentations of those aged 75 years and over at the RHH represent more than 10% of all ED presentations and over 22% of all

admissions, with the proportion increasing each year of this study. Presentations in this age group are increasing at a rate of 12.5 per 1,000 residents per year, with 68% of these presentations resulting in an admission in 2013-14. The amount of time this group spent in the RHH ED in 2013-14 is equivalent to over four ED cubicles per day being occupied by a person aged 75 years or over.

Other Australian studies have identified presentations by the elderly as one of the factors contributing to increased ED presentations. In a ten-year retrospective analysis of all ED presentations in metropolitan Melbourne, older people (defined as aged 70 and over) were identified as being disproportionately represented in ED.[206] Similar to our study, the Melbourne study found older patients spent longer in the ED and were more likely to be admitted than younger adults.[206] A retrospective analysis of ED presentations undertaken in Sydney, Australia attributed a 36% increase in ED presentations over eleven years to be predominantly driven by the growth in acute, elderly presentations requiring hospital admission.[88] A recent Japanese study that investigated the relationship between ED length of stay (LOS) and the trend of an aging society concluded that the age of ED presenters had a significant negative effect on ED crowding, as EDLOS increased proportionately with the mean age of ED presenters.[183] Kawano and colleagues further advised that countries facing the issue of an aging population anticipate the effect this will have on ED crowding and take preventative measures to address the potential impact on the healthcare system.[183]

As Tasmania has the highest mean age of all Australian states and territories any significant or sustained growth in ED presentations of those aged 75 and over is a major concern. Not only is the state population of this demographic forecast to continue increasing, but the burden in terms of time and resources this group place on the ED is already significant. It is important to note that, as these results show an increase in per capita presentations, the issue is not simply that a greater number of older people are attending the ED, but each older person in the South is more likely to attend.

This result merits further investigation into the causes behind this significant increase in ED presentations by those aged 75 years and older. Future research could investigate whether older residents of the South are sicker than before, and therefore require more hospital admissions. Additionally, an exploration of older residents' perceptions of access to primary care may yield some insights into what is driving this increased need for emergency care.

4.4.4 State-wide presentations

Finally, the state-wide analysis identified increases in high acuity presentations and patients arriving by ambulance to the ED. This appears to be consistent with the increased acuity of ED presentations, demonstrated by a 23% increase over four years in the proportion of presentations who were subsequently admitted. The increase in admissions was evident across all three regions (Table 4.1). Indeed, the admission rate of 33% in the South in 2013-14 was higher than the Australian average for the same period (29%).[193] A report by the Tasmanian government has previously highlighted the strain that increased hospital admissions are placing on the healthcare system.[34] This report identified Tasmanian EDs as having higher levels of access block than the national average, with 36% of all Tasmanians spending greater than eight hours in the ED, compared with 27% nationally (2012-13).[34]

Similar to the current study, Lowthian and colleagues also identified substantial increases in the proportion of ambulance arrivals, high acuity patients and ED presentations subsequently requiring an admission over a 10-year period in Victoria, Australia.[90] Increased ED presentations related to the growth in high acuity patients was also a finding of a Western Australian (WA) study that examined trends in state-wide ED presentations over seven calendar years (2007-2013).[177]

The current study adds to the growing body of evidence that high acuity patients who require admission to an inpatient bed are contributing substantially to the increase in ED presentations. This result suggests that health care policy needs to incorporate effective health promotion measures to keep the population healthier, and to consider whether alternative services for people with chronic diseases can reduce the need for hospital admissions. It is known that solutions to crowding in EDs lie outside of the ED itself; therefore, a concerted effort to identify the causes of increased ED presentations and develop system-wide solutions that are both appropriate and acceptable to local residents is necessary.

4.4.5 Limitations

Australian Bureau of Statistics (ABS) population data were used to calculate per capita presentations. Therefore, the patterns of per capita presentations are reliant on these population data, which are estimates based on updates to 2011 Australian census data.

Analyses of the trends in clinical diagnoses presenting to ED may be helpful in describing the profile of presentations but was beyond the scope of this paper.

4.5 Conclusion

This study provides a comprehensive analysis of patterns of ED presentations by Tasmanian residents over a four-year period. The analysis highlights sizeable regional variations in patterns of ED usage which suggests that interventions aimed at reducing ED presentations need to be based on local knowledge to ensure local issues are taken into consideration. Results also indicate that a significant proportion of the increase in ED presentations in Tasmania is related to increased presentations by those aged 75 and older in the south of the state. Further research to ascertain the drivers behind these significant changes in health care usage in Tasmania, including trends in the types of presenting conditions and referral sources, would provide useful insights into how best to plan for and manage future impacts on hospital resources.

4.6 Unpublished data

Due to word count limitations in the chosen journal, *International Emergency Nursing,* analysis investigating the effect of socioeconomic status (SES) on ED utilisation was not included in the final publication. The next section will provide the method and results of this analysis.

Method

Presentations by socioeconomic status

We were interested in ascertaining whether socioeconomic status (SES) played a role in ED utilisation. The ABS developed a product that ranks areas in Australia according to relative socioeconomic advantage and disadvantage, the Socio-Economic Indexes for Areas (SEIFA).[207] As the SEIFA is an ordinal measure, the ABS recommends using index rankings or quantiles for analysis. In the case of SEIFA, the distribution of scores are divided into ten equal groups or deciles. The lowest scoring 10% of areas are given a decile number of 1, the second-lowest 10% of areas are given a decile number of 2 and so on, up to the highest 10% of areas, which are given a decile number of 10.[208] We created a decile variable to divide the data into areas of low (deciles 1-3), middle (deciles 4-7) and high (deciles 8-10) SES. We used descriptive statistics to compare trends in ED presentations between levels (low, middle and high) and by ATS over time.

Results

The role of SES on ED presentations in Tasmania

Comparing trends in ED presentations by SES (low, middle and high) identified a slight over representation of those coded as residing in the areas of lowest SES (deciles 1-3). Those resident in the areas allocated deciles 1-3, who accounted for 30% approximately of the population, accounted for 40% of all presentations. The 40% of residents of areas allocated deciles 4-7 accounted for 38% of all presentations whereas the 30% allocated as deciles 8-10 accounted for 22% of all presentations on average. There were slight increases noted in all groups with the annual average percentage change in ED presentations being 0.4%, 0.9% and

2.7% in residents ranked as residing in areas of low, middle and high SES by decile respectively (data not shown).

When presentations were divided in high and low acuity the patterns were very similar. When examining high acuity presentations, residents living in areas of low, middle and high SES represented 39%, 38% and 23% of ED presentations, respectively. Some increases were seen in all three groups over the four-year period, with annual average increases of 2.2%, 2.5% and 1.7%, respectively in areas coded as low, middle and high SES (data not shown).

Analysis of LAPs by SES identified comparable patterns. Residents coded as living in areas of low, middle and high SES represented 40%, 38% and 22% of ED presentations, respectively. Only those resident in areas coded as high SES recorded an overall increase in low acuity ED presentations, with an annual average increase of 3.4% over the four-year period. LAPs by those coded as living in areas of low and middle SES recorded annual average decreases of 0.8% and 0.2%, respectively (data not shown).

4.7 Benefits and limitations of retrospective studies

Although retrospective studies can be seen to be scientifically inferior to prospective and longitudinal studies,[62, 209] there are several benefits to undertaking research using retrospective data. In retrospective studies the data has already been gathered thereby making the study cheaper and potentially less time consuming. This is an advantage in health services research where budgets and timelines for research are often constrained. As the data has already been gathered, retrospective studies tend to be larger than prospective studies.[210] In Phase 1 of the current study, a retrospective ED dataset was used to identify trends in ED utilisation in Tasmania over four years. As every member of the Tasmanian population had equal opportunity to attend any of the EDs in the state over this timeframe, the dataset can be said to be reasonably representative of the Tasmanian population,[211] making the findings somewhat generalisable to the Tasmanian population. A commonly cited limitation of studies utilising retrospective data is that, as the data was not gathered for the purpose for which it is being used, that data may be of poor quality.[210] As it is a Commonwealth Government requirement in Australia that ED data be gathered in a consistent format and sent to the Australian Institute of Health and Welfare (AIHW) (a Commonwealth governed department), where it is reported on annually and used to

benchmark hospitals against their peers,[193] it is reasonable to assume that the dataset was of a high quality.

4.8 Chapter summary

Although increased ED presentations by the elderly with complex and chronic conditions has been identified as an emerging cause of ED crowding, there is a dearth in the literature as to what is driving this increase. From the sparse evidence available, it is clear that patient-perceived access to care is considered to be a contributing factor. The findings of this research project so far have included:

- A systematic review of the international literature that highlighted:
    - A dearth in the published literature as to the specific causes of ED crowding
    - Elderly patients with complex and chronic health conditions as an emerging (and not the single) driver of ED crowding (nationally and internationally)
- A thorough analysis of four-years of ED presentations in Tasmania that highlighted:
    - The greatest increase in ED presentations were in the South of the state (Table 4.1)
    - Increased ED presentations across all age groups in the South; however, the increase in those aged < 60 years was predominantly for low acuity presentations (Figure 4.2)
    - A significant increase in ED presentations in the South by those aged ≥ 75 years across all levels of acuity (10% per capita increase over 4 years) (Figure 4.1)
    - That approximately 70% of those aged ≥ 75 years who presented to ED were then admitted (at a rate over 5 times greater than those aged <75 years) (Table 4.2)
    - That those aged ≥75 years spent longer in the ED than those aged <75 years, regardless of whether they were ultimately admitted or discharged (Table 4.2)
    - Both the higher admission rate and longer length of ED stay can lead to access block, an agreed cause of ED crowding

As at this time there were other groups studying ED presentations in the states North,[203] and NW,[188] it was decided that the focus of this research would be on investigating the drivers of the 16% increase in ED presentations identified in the South of the state.

Taking into account that: worldwide the population is ageing, Tasmania has the highest mean age of all Australian states and territories and this is set to continue, both the literature (Chapter 2) and the ED data analysis (Chapter 4) identified elderly patients as one of the drivers of ED crowding in this region, and given the emergent mixed methods design of this study, the decision was taken that the remainder of this thesis would investigate the role of patient-perceived access to care in ED utilisation by the elderly. Consequently, the following chapter will provide an overview of the research into access to healthcare.

Chapter 5. Access to healthcare and how it is measured

"Give people what they need: food, medicine, clean air,
pure water, trees and grass, pleasant homes to live in,
some hours of work, more hours of leisure.
Don't ask who deserves it. Every human being deserves it."
— Howard Zinn, Marx in Soho: A Play on History

5.1 Introduction

The previous chapter identified that the majority of the increases in ED presentations in Tasmania are concentrated in the South of the state, with significant increases in per capita presentations by residents of the states South aged ≥ 75 years. Although other jurisdictions are beginning to report similar increases in ED utilisation by elderly patients,[88, 90, 112, 184, 206, 212] there remains a dearth in the literature explaining the drivers behind this emerging cause of ED crowding. However, the available research does suggest that patient's perceptions of access to healthcare may be a factor.[110, 186, 213-215] Consequently, the remainder of this thesis will investigate the role of perceived access to care in ED presentations by the elderly. This chapter will provide an overview of the research into access to healthcare.

Access to healthcare is a complex subject and quite a difficult concept to explain. What does access mean? Who has access? What does access look like? How does access differ from perceived access? And how do we measure an individual's access to healthcare? It might be assumed that if a large number of health care options are provided, whether they be GP surgeries, after-hours clinics, outpatient's appointments, pharmacies, or EDs, then people must have access to the health care services they require. However, in some of the earliest access research, Donabedian questioned this belief that access was purely concerned with the availability of a service, when he stated that '*the proof of access is use of service, not simply the presence of a facility*'.[216(p.111)] Indeed, if services are not geographically situated in the localities that most require them, open at hours suitable to potential patients, perceived by users as appropriate to their needs, or affordable, can we really say that the population has access?

The next section will provide some definitions of access and discuss the development of the concept of patient-perceived access to healthcare, incorporating the development of the

domains of access. Research into potential consequences of unrealised access to required services will also be presented. Finally, there will be a discussion on the development and use of PPHs as a measure of patient-perceived access to care.

5.2 Definitions of access

In order to understand access to care, and to assess whether in fact consumers have access to the care they require, it is necessary to first understand what the term, 'access to care' means. As access research developed, beginning in the mid-20th century and continuing up to the present day, many definitions have been put forward and expanded, as the concept has become better understood. Some of these definitions are displayed in Table 5.1.

Table 5.1 Definitions of access.

WHO, 1978[217]	*'Accessibility implies the continuing and organised supply of care that is geographically, financially, culturally and functionally within easy reach of the whole community. The care has to be appropriate and adequate in content and in amount to satisfy the essential health needs of the people, and it has to be provided by methods acceptable to them'*
Aday and Andersen, 1981[218]	*'..those dimensions which describe the potential and actual entry of a given population group to the healthcare delivery system'*
Khan and Bhardwaj, 1994[219]	*'…the outcome of a process, determined by an interplay between the characteristics of the healthcare service system and the characteristics of potential users in a specified area, and moderated by healthcare related public policy/ planning efforts'*
Rogers et. al, 1999[220]	*'Optimal access means providing the right service at the right time in the right place'*
Gulliford et. al, 2002[221]	*'Facilitating access is concerned with helping people to command appropriate healthcare resources in order to preserve or improve their health'*
Haggerty et. al, 2011[222]	*'..health services are accessible if their specific characteristics– geographic availability, organization, price, acceptability and so on – allow a broad range of persons to reach, enter and use them'*
Corscadden et al., 2017[223]	*'..the capacity of people to obtain appropriate services in response to need for care'*

As can been seen from the above, from the earliest research into access to health care services, it has been widely accepted that access cannot simply be measured in terms of availability of services alone. Khan and Bhardwaj discussed this in terms of

spatial/geographical access and aspatial/social access, and argued that both need to be looked at in terms of opportunity and cost to get a real understanding of the barriers to access faced by potential healthcare users.[219]

Whilst availability is important, it is mainly a systems issue and largely lies outside of the individual's control. Other aspects of access, specifically aspects over which the individual has some control, for example, the ability to perceive the need for care or the individual's perception of the acceptability of their service provider, have moved much more to the fore in terms of understanding access to care from the client's perspective. The next section will give a brief overview of the history of access to care research.

5.3 A history of access research

5.3.1 Health service utilisation

The early work on access to care began in the United States of America (USA). In 1973, Andersen and Newman suggested that health service utilisation could be viewed as *'a type of individual behaviour',*[224(p.2)] with the behaviour being a function of the person themselves, the features of the environment in which they live, and the interaction of both individual and societal forces.[224] They developed a framework of healthcare utilisation, suggesting that both societal norms and the health system itself influence the individual, with societal determinants also affecting the health system (Fig. 5.1).[224] Examples given of societal norms that had affected healthcare utilisation at that time (early 1970s) included vast increases in the numbers of births and deaths taking place in public hospitals compared to 20 to 30 years earlier, as well as changes in the financing of medical care.[224]

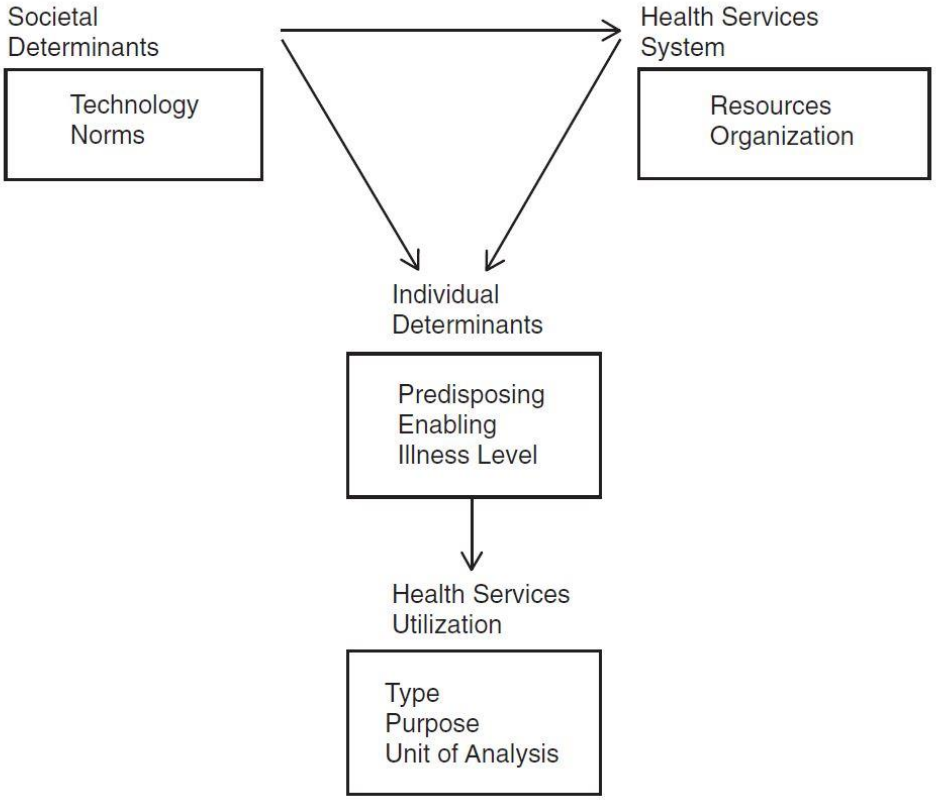

Figure 5.1 Andersen's framework for viewing health services utilisation[224]

5.3.2 Individual determinants of health service utilisation

While agreeing that societal effects were important, Andersen and Newman felt that, to truly understand access, we also need to understand the individual characteristics of people that lead to them seeking health care. They developed a model that portrayed the individual determinants for health service utilisation (Fig. 5.2).[224] They chose the components of the model based on previous research that had shown their relationship to healthcare use. These researchers acknowledged that although the predisposing factors, such as gender and age, had been shown to lead to increased healthcare use, the factors themselves were not directly responsible for this use.[224] The enabling factors facilitate those who are predisposed to seek health care to enter the system, whether this be because they can afford required care (income) or because the service is geographically available to them. Finally, how the individual perceives illness will also determine their use of the healthcare system. In trying to modify

healthcare utilisation, it is important to recognise that some of the factors in the model are adaptable, for example ratios of health personnel, whilst others are pre-set, for example age and race.

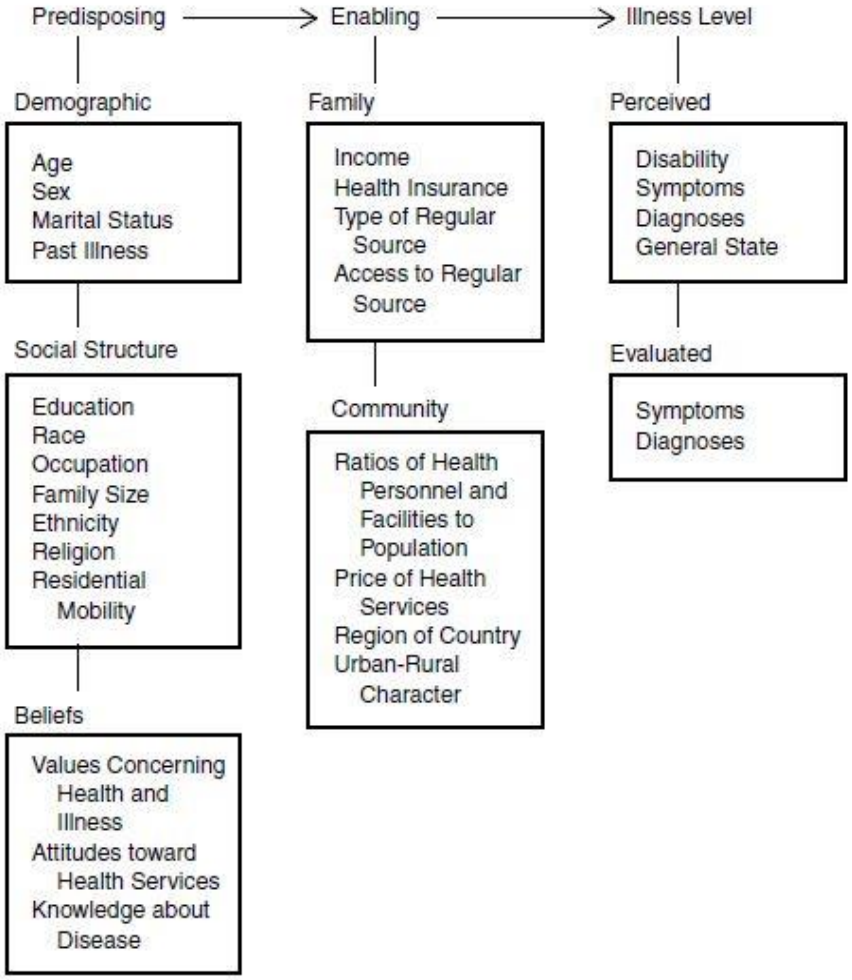

Figure 5.2 Andersen's model of the individual determinants of health service utilisation[224]

5.3.3 The domains of access to care

In the early 1980s, Penchansky and Thomas defined access as, '*a concept representing the degree of "fit" between the clients and the system*'.[225(p.128)] They likened this to the enabling variable included in Andersen's original model.[224] Penchansky and Thomas were of the opinion that, whilst access was a general concept, there were five dimensions of access that represented more specific areas of 'fit' between the healthcare system and potential users

(Table 5.2).[225] They undertook questionnaire research among a population of spouses of manual labourers in a car factory in New York to investigate the factors that influenced an individual responder's choice of health care, assuming that lack of satisfaction would decrease utilisation of services. In total, 287 completed surveys were included in the study. They tested both the discriminate and construct validity of the survey tool, based on responses by that population, and concluded that all five dimensions were relevant to patients' choice of provider.[225]

Table 5.2 Penchansky and Thomas' dimensions of access.

Dimension	Definition
Availability	The relationship between the availability of required services in relation to the client's needs, including physicians, dentists and specialist services.
Accessibility	The relationship between the location of services relative to the clients who require them. Also, takes into consideration availability of transportation, travel time and travel costs.
Accommodation	The relationship between the services ability to accept clients, including such things as the appointment system and opening hours, and the client's ability to accommodate to these factors.
Affordability	The relationship between health care costs to the client's income. Also includes the client's perception of value for money.
Acceptability	The relationship between the characteristics of the provider and the client's attitude towards these characteristics. Also concerned with the provider's attitude about personal characteristics of clients.

Penchansky and Thomas[225]

However, following their original work, Penchansky and Thomas had many critics who, through their own research, found that rather than all domains of access influencing healthcare utilisation, only the ability to pay (affordability) or having a regular source of care (acceptability) explained variations in utilisation. Thomas and Penchansky argued that others had come to this conclusion as subsequent studies looked at the behaviours of the total population, rather than adhering to Andersen's model,[224] which included demographic factors as predisposing factors to healthcare utilisation.[226]

Using the same data they had used to validate their domains of access taxonomy,[225] Thomas and Penchansky undertook further analysis to test the hypothesis that neither patient demographics, nor measures of satisfaction with access, would be significant predictors of utilisation, if the analysis used the entire sample.[226] Their initial results proved this hypothesis.[226] From this, they concluded that no simple monotonic relationship could be applied to the population as a whole. However, using step-wise regression analysis, adding patient demographics, including age, gender, race, educational attainment and level of employment, to examine health service utilisation and satisfaction with the service, they found that utilisation behaviour was related to patient sociodemographic characteristics.[226] They concluded that:

> The relative importance (salience) of the dimensions of access might differ for the strata examined; that is, different patterns of relationships between satisfaction with access and utilisation behaviour may exist for demographically different groups of patients.[226(p.565)]

This was an important finding as it made it clear that, as well as understanding the different domains of access and how these affect patients' use of and satisfaction with healthcare services, within populations there are different factors influencing access, depending on the potential client's sociodemographic characteristics. In short, realised access to healthcare is dependent on contextual specific factors. As one group of Australian researchers concluded '*optimum use of PHC* [Primary Health Care] *requires the provision of appropriate care in line with the needs and preferences of communities.*'[227(p.125)]

5.3.4 Revising the domains of access

In 2013, a Canadian group undertook a synthesis of the published literature on the conceptualisation of access based on the most cited frameworks, and developed a revised conceptual framework (Fig. 5.3).[228] Although the model incorporated many of the original, although slightly revised, domains of access as proposed by Penchansky and Thomas,[225] this new model went further. As well as five domains of access, it included five related abilities of potential health care users to interact with the domains to facilitate access.[228]

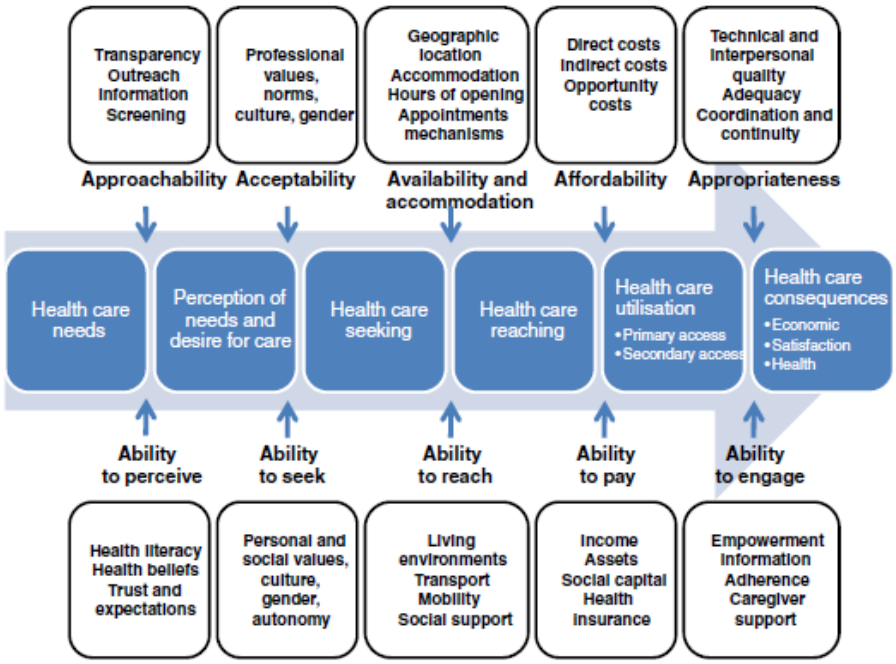

Figure 5.3 Levesque's conceptual framework of access to healthcare[228]

Approachability → ability to perceive

This domain relates to the fact that users can identify that a facility exists and what services the facility provides. Services have the ability to make themselves more or less 'approachable' by advertising their services (or not) to different social or geographical population groups. The concept of the 'ability to perceive' relates to the health literacy of the individual and their ability to perceive the need for care, coupled with their beliefs about health and illness.

Acceptability → ability to seek

This domain concerns itself with the cultural and social factors of potential users and how this interplays with the potential user's ability to accept that service. For example, in certain religious groups, it is forbidden for a woman to be alone with a man who is not a member of her family. If health care is predominantly provided by men, this service may not be acceptable to these women. The ability to seek care relates to the individual's autonomy in relation to their health care options and the capacity to seek care.

Availability and accommodation → ability to reach

This domain relates to whether health care services can be physically reached and accessed in a timely manner. Availability relates to the physical existence of a facility or health care provider, whilst accommodation relates to how well the facility/organisation accommodates potential users, for example, are appointments available at times suitable to users? The ability to reach health care relates to the location of services in relation to availability of transport, as well as the ability of the user to access appointments at times that accommodate their daily lives, such as the availability of appointments outside of the users' normal working hours.

Affordability → Ability to pay

Perhaps the most widely accepted access domain, affordability, concerns itself with the financial cost of care, as well as transport costs and potential lost income when seeking care. Perceived quality of care is also relevant here. The ability to pay for required care, which may seem self-explanatory, is described by Levesque et al. as *'the capacity to generate economic resources - through income, savings, borrowing or loans - to pay for health care services without catastrophic expenditure of resources required for basic necessities'.* [228(p.6)] Living in poverty would constitute an example of a user who lacks the ability to pay.

Appropriateness → Ability to engage

This domain relates to the appropriateness of services related to the needs of clients. It relates to the quality of the services provided. For example, access is not considered appropriate if, due to geographic location or cost, a potential user has an option only to choose poor quality providers from whom different, unequal outcomes can be expected, when compared to other, higher quality providers. The ability to engage relates to the individual's ability to be involved in decisions regarding their care. Health literacy and the capacity of the individual to communicate with the health care provider are important here.

These domains of patient-perceived access to care will be referred to later in this thesis as they were used as a framework to both develop questions and analyse responses from elderly patients who had experienced a recent PPH (Chapter 8).

5.4 Consequences of unrealised access to care

Whilst it is important to understand what the term 'access to healthcare' means, it is essential to appreciate what it means for patients when they are unable to access the health care they perceive they require. As has previously been established, some problems with access are related to systems level issues, such as the availability of services in the areas that most require them. However, some barriers to access are related to the attributes of the clients who perceive the need for care.

Four potential consequences to unrealised access were identified by a group from Canada, who explored the differences in the health-seeking trajectories of rural versus urban residents.[229] Haggerty and colleagues conducted focus groups in one urban and three rural settings, with community-dwelling adults who had used or required health care services in the selected study areas. Participants were asked to imagine they required urgent but not life-threatening care. The investigators explored participants' first preferences for care, actions participants took to try to realise this care, and alternative actions taken when barriers to care were encountered.[229]

Results of this research identified six steps in the process from the client first recognising they required access to healthcare to the client achieving this access, along with six potential barriers to achieving access, and four potential consequences if access was not realised (Fig. 5.4). They found that any barrier could potentially lead to any consequence. Potential consequences were mentioned in all of the focus groups (urban and rural) and were listed in the model in descending order of likelihood; 'restart care-seeking process', 'go to hospital emergency room', 'abandon care-seeking', 'deterioration of health' (Fig. 5.4).[229] Although all of these consequences are significant for the patient, for the purposes of the current research project, the decision to 'go to hospital emergency room' when faced with barriers to access is a concern.

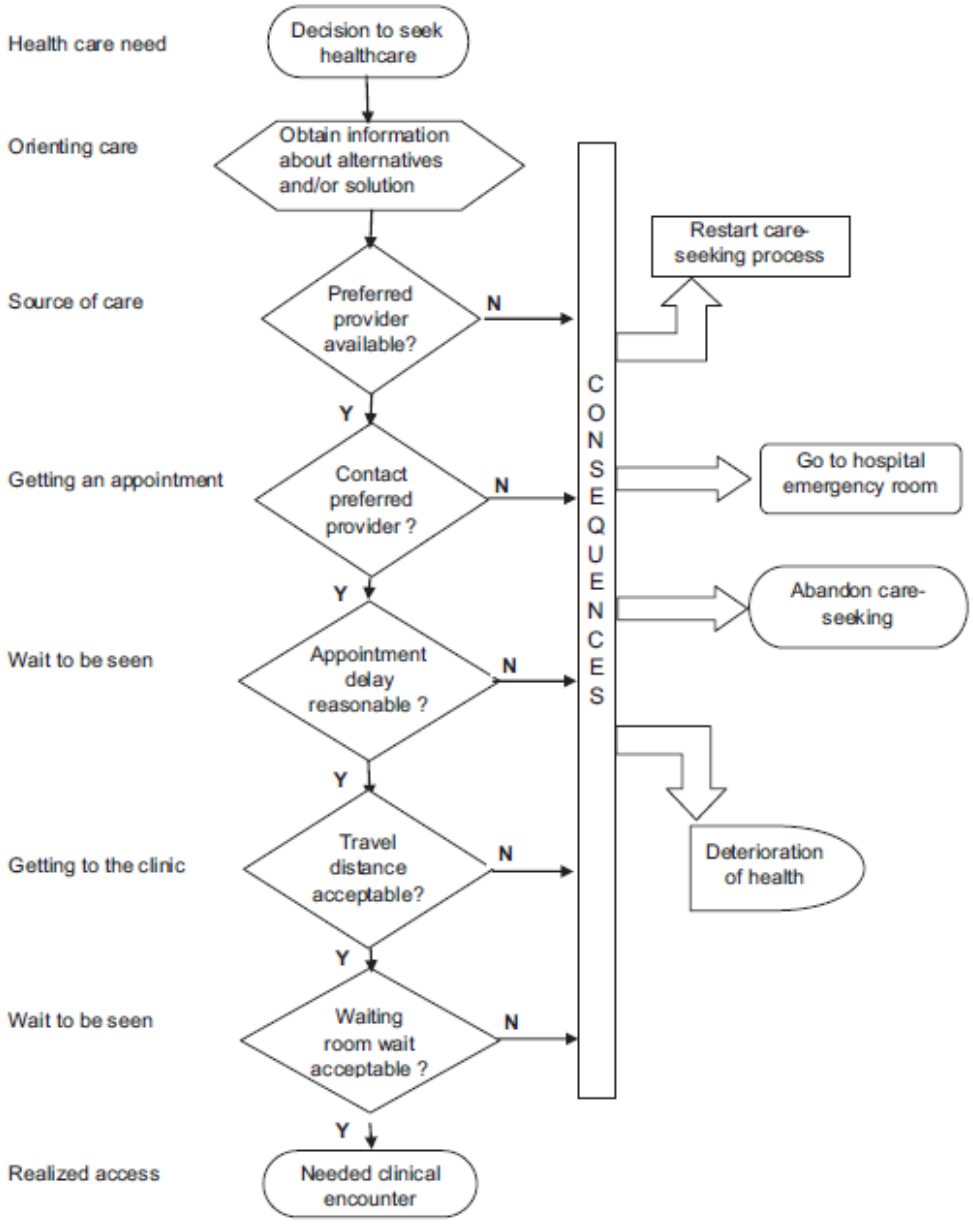

Figure 5.4 Haggerty's flowchart of typical care-seeking trajectory [222]

Whilst the premise of the current research is not that inappropriate or 'GP-type' patients are driving the increase in ED presentations in Tasmania, Haggerty et al's[229] findings highlight the fact that, when faced with barriers to accessing primary care, patients do often choose to attend the ED instead. This may be early in the care-seeking process, which may be reflected by lower levels of acuity, as measured by ED triage scores. Or, it may occur later in the process, when the patient has 're-started [the] care-seeking process' a number of times, or 'abandoned care-seeking' which has led to a 'deterioration of health'. These patients would

potentially present to the ED when more acutely unwell, possibly requiring hospital admission. Although well before Haggerty's findings, when examining the impact of socioeconomic status on hospital use in New York in 1993, Billings et al. also alluded to the role that the domain of acceptability played in patient-perceived access to care and increased ED utilisation when they stated

> Patients who resist use of a local clinic because the provider does not speak their language or is not sensitive to their customs are clearly at increased risk of delaying care and are more likely to use the hospital emergency room as an entry point to the system[230(p.172)]

An important finding of Haggerty's[229] research was that the more socially integrated an individual was, the less difficulties they faced in accessing required care, regardless of barriers encountered. They found that rural residents often experienced more accommodation to their needs, directly related to their social connectedness to smaller, rural communities, thereby often making it easier to access primary care services.[229] The negative side to this finding is that those who are less socially connected often experience more barriers to access. Unfortunately, those less socially connected in society often tend to be those most in need of care, such as those from lower socioeconomic backgrounds, with lower health literacy, or the elderly in rural areas whose families have moved away.

A similar finding of social isolation in the elderly, leading to barriers in accessing required care, was reported in a study in Queensland, Australia. Greaves and Rogers-Clark[231] undertook in-depth interviews with six individuals aged ≥ 75 years with limited social contact. They reported participants describing a 'spiral of deterioration', based around social isolation, being old and getting sicker. Fear was the central feature of these participants experience, which seemed to commence with deteriorating health but was escalated by the difficulties they experienced in accessing appropriate health care.[231] Reported barriers to care included issues of waiting for appointments, transport, and powerlessness to do anything other than accept what was offered.[231] Looking at these barriers through the lens of the domains of access, it could be said that the participants in Greaves study[231] had poor perceived access to care under the domains of accommodation and appropriateness.[228] The powerlessness to do other than accept the care that is offered indicates a lack of the ability to engage with care providers and work in partnership with providers to ensure acceptable outcomes for patients.

Similarly, the stated barriers of waits for appointments and lack of transport highlight issues with the ability of the patient to physically reach health care at a convenient time. Access barriers to care for the elderly[213, 232] and rural dwellers[233, 234] have been highlighted in other research and require further investigation if we are to ensure the provision of equity of access to health care for all, as proposed by the WHO.[217]

5.5 Access to care in Australia

In Australia, some domains of access to PHC have been reported to be more problematic than in other countries with comparable healthcare systems. Corscadden et al.[223] undertook a secondary analysis of the 2013 Commonwealth Fund International Health Policy Survey, which was originally conducted to *'identify organisational innovations designed to improve access to appropriate PHC* [primary health care] *for vulnerable populations'*.[223(p.224)] The survey included respondents from 11 countries: Australia, Canada, Germany, France, Netherlands, NZ, Norway, Sweden, Switzerland, the UK and the United States. Results reported that Australia ranked sixth out of eleven in terms of problems with availability of PHC, and eighth in terms of problems with affordability.[223]

Callander et al. undertook a cross-sectional analysis using linear and logistic regression models and applied it to the 2013 Commonwealth Fund data used in the study reported above.[235] They found that Australian adults with chronic health conditions were more likely to forgo care than chronic health sufferers in seven of the eleven countries included in the analysis. When looking at Australian data alone, Australians with chronic conditions had much larger out of pocket health care expenses than those who reported no health condition, and were more likely to skip health care treatment because of cost when compared to those reporting no health care condition.[235] In percentage terms, this research reported that up to 44% of chronic health suffers in Australian skipped health care treatment because of cost.[235] This report should be of real concern to the Australian government, whose current spending on potentially avoidable hospitalisations for chronic conditions is estimated at $2 billion annually.[236] With chronic disease now causing the greatest burden of ill health in Australia,[237] and an increasing proportion of health care expenditure,[238] if increasing numbers of patients with chronic conditions choose to forego 'unaffordable' primary care, the inevitable cost to the acute care system will become untenable.

Another study that investigated the relative importance of the different dimensions of access in the decisions of rural Australians to utilise PHC found that preference for and availability of a preferred GP consistently ranked higher than cost or distance.[227] This preference for continuity of care with a preferred GP remained the case regardless of whether respondents lived in sparsely populated or closely settled areas. Ward and colleagues concluded that their survey research of five rural communities showed that rural communities are prepared to make 'trade-offs' in terms of distance and cost when trying to access PHC.[227] These findings add further weight to the argument that realised access to healthcare is reliant on contextually specific factors, which are dependent on the particular population of interest. Therefore, a 'one size fits all' model for improvement of access to healthcare is unlikely to be successful. In order to understand access to care from the patients' perspective, and to investigate whether in fact barriers to required care exist, it is important to have a standard measure of access. Consequently, the next section of this thesis will discuss the current internationally accepted measure of patient-perceived access to care, PPHs.

5.6 Potentially preventable hospitalisations

Potentially Preventable Hospitalisations (PPHs), also known as Ambulatory Care Sensitive Hospitalisations (ACSHs) or potentially avoidable hospitalisations are:

> those conditions where hospitalisation could have potentially been prevented through the provision of appropriate individualised preventative health interventions and early disease management usually delivered in primary and community-based care settings (including by general practitioners, medical specialists, dentists, nurses and allied health professionals).[40(p.93)]

[ii]PPHs consist of a set of conditions easily identifiable from diagnosis codes in hospital admissions data. In Australia there were 680,000 PPHs, or 6% of all hospital admissions, accounting for 2.7 million bed days in 2015-16.[239] It is estimated that PPHs cost the National Health System in the UK £1.42 billion in 2012,[240] while figures for chronic PPHs in Australia have been estimated at $2 billion a year (2010-11).[236] Current healthcare reform in Australian

[ii]The phrases Potentially Preventable Hospitalisations (PPHs), Ambulatory Care Sensitive Hospitalisations (ACSHs) and potentially avoidable hospitalisations are used interchangeably. In the interests of clarity and consistency, the phrase PPHs will be used from this point onwards in this thesis to indicate all or any of the above, regardless of which phrase/acronym was used in the study being discussed.

aims to reduce PPHs, with the goal of improving patient outcomes, as well as reducing pressure on hospitals.[241] The rate of PPHs is a National Healthcare Agreement performance indicator in Australia, relating to the outcome that '*Australians receive appropriate high quality and affordable primary and community services*'.[40(p.93)]

Similarly, PPHs are used as an indicator of the quality and accessibility of primary and community care in NZ, the UK, the USA and Canada.[242] However, the list of conditions considered potentially avoidable varies between countries,[243] making between-country comparison difficult. The current list of 22 conditions included in the health performance indicator in Australia is shown in Table 5.3. There are three broad categories of PPHs (Table 5.4), with differing definitions and potential means of admission avoidance.

Table 5.3 Conditions for which hospitalisation is considered potentially avoidable.

Vaccine-preventable conditions	Acute conditions	Chronic conditions
• Pneumonia and vaccine-preventable influenza • Other vaccine preventable conditions	• Pneumonia (not vaccine-preventable) • Cellulitis • Convulsions and epilepsy • Eclampsia • Dental conditions • Ear, nose and throat conditions • Gangrene • Pelvic inflammatory disease • Perforated/bleeding ulcer • Urinary tract infections including pyelonephritis	• Angina • Asthma • Chronic obstructive pulmonary disease • Congestive cardiac failure • Diabetes complications • Hypertension • Iron deficiency anaemia • Nutritional deficiencies • Rheumatic heart disease • Bronchiectasis

Australian Institute of Health and Welfare (AIHW)[40]

Table 5.4 Categories of potentially preventable hospitalisations.

Vaccine-preventable conditions Diseases that can be prevented by proper vaccination, including influenza, bacterial pneumonia, hepatitis, tetanus, diphtheria, pertussis, chicken pox, measles, mumps, rubella, polio and haemophilus meningitis. The conditions are considered to be preventable, rather than the hospitalisation.
Acute conditions Conditions that may not be preventable, but theoretically would not result in hospitalisation if adequate and timely care (usually non-hospital) were received.
Chronic conditions Conditions that may be preventable through behaviour modification and lifestyle change but can also be managed effectively through timely care (usually non-hospital) to prevent deterioration and hospitalisation.

Australian Institute of Health and Welfare (AIHW)[40]

5.6.1 Development of the term

The seminal work identifying a set of conditions where hospital admission could potentially be avoided through the provision of early and appropriate ambulatory care was undertaken by an American group in 1993.[230] Using a modified Delphi approach, a medical advisory panel of six experts defined three categories for grouping causes of hospital admissions: (i) conditions for which more timely outpatient care is unlikely to have an impact on the need for admission (e.g. AMI), (ii) conditions which, with timely outpatient management, should be amenable to a reduction in hospitalisation, whether through prevention, controlling the onset of acute illness, or managing a chronic condition (PPHs) and (iii) conditions requiring surgery which may be avoidable if outpatient speciality care is provided (e.g. knee replacement surgery). They then compared hospitalisation rates for these three groups of conditions for a population in New York, using level of income as a proxy for socioeconomic status, as the dependent variable.[230] The study included all residents of 164 Zip codes in New York aged < 65 years, as this population was hypothesised to experience more barriers to healthcare access than older residents.[230]

The population residing in low-income areas were reported to have substantially higher admission rates than high-income areas for conditions identified as being potentially preventable, whereas no significant differences were reported for admissions in conditions described in the other two groups. A peak in the difference in hospitalisation rates between high and low-income residents in the age 25-44 cohort was also identified, particularly for acute PPHs, such as pneumonia or cellulitis.[230] Billings and colleagues hypothesised that this was due to the fact that this particular cohort faced bigger barriers in accessing care than the very young and the very old, who were able to avail of state provided insurance (Medicaid). Even after making adjustments for other variables such as race, disease incidence/prevalence, lifestyle factors and physician decision making, Billings reported large and pervasive differences in hospitalisation rates between low and high-income areas for PPHs.[230]

Another group examined the PPH rate for five chronic conditions only (asthma, hypertension, CCF, COPD and diabetes) and their relationship to income level, patient-perceived access to care, prevalence of disease, propensity to seek care and physician admitting style.[244] Bindman and colleagues found that both self-related access to care and prevalence of condition independently predicted PPHs,[244] thereby validating Billings[230]

findings. This was the beginning of the use of PPHs as a measure of patient-perceived access to healthcare. Using methods similar to Billings,[230] over the next 20 years groups of experts from the UK,[245] Canada,[246] Australia[247] and Spain[248] developed similar but separate lists of PPHs. These different groups agreed on between eight[246] and nineteen[248] conditions considered to be amenable to management outside of the hospital setting, with some overlap between all groups.

5.6.2 Potentially preventable hospitalisations as a measure of patient-perceived access to care

In 2006, noting that over the previous decade rates of PPHs were increasingly used as a measure of access to healthcare, an Australian group set out to examine their external validity as an indicator of healthcare access.[249] This group used hospital discharge data and International Classification of Diseases 9th revision (ICD-9) codes for PPHs to calculate standardised admission rates for PPHs for those aged over 18 years in the state of Victoria, Australia (population 4.4 million). They also used the Victorian population health survey to measure access to care, propensity to seek care, prevalence of PPHs, potential social contributors to PPHs and selected behavioural risk factors. They used the Accessibility Remoteness Index of Australia [iii](ARIA) to examine the effect of isolation on PPH rates, as well as effects of rural or urban residence. Finally, they used hospitalisations for appendicitis as a 'pseudo control', as hospitalisation for appendicitis was not deemed to be avoidable by providing better access to primary care. The group's hypothesis was that greater access to healthcare would be associated with fewer PPHs.[249]

Ansari and colleagues found that communities that reported problems with access had higher admission rates in all PPH categories, with self-related access accounting for 30% of the variation.[249] They also found that propensity to seek care and disease burden were not significantly associated with PPHs; PPHs were associated with low income, low education and smoking; PPHs were negatively associated with the number of primary care provider visits; and, no relationship was found between access and hospitalisation for appendicitis.[249] They concluded that their study had found evidence of a negative relationship between patient-

[iii] The ARIA is a continuous variable that measures road distances to centres that provide goods, services and social interactions.

perceived access to healthcare and PPHs, and therefore provided some support of the validity of PPHs as a measure of access to healthcare.[249]

Furthermore, in a review of the literature published the following year that examined the usefulness of PPHs as indicators of quality and access to primary care, Ansari and colleagues concluded that PPHs are a valid proxy indicator of access to primary health care.[250] This finding was reinforced by another systematic review five years later.[251]

5.6.3 Potentially preventable hospitalisations and supply of primary care

The relationship between primary care physician supply and PPHs has been studied extensively, primarily in America. Studies have reported that patients who experienced more availability and accessibility of primary care services, had fewer potentially avoidable admissions,[252-255] although some reported differences between rural and urban dwellers.[253, 254]

Conversely, more recent Australian[256] and NZ[257] research reported no relationship between GP supply and rates of PPHs. The Australian study used results from a self-reported questionnaire and linked this with administrative hospital data to identify PPHs.[256] Falster and colleagues found that GP supply was not a significant predictor of PPHs and concluded that sociodemographic and health characteristics were the major drivers of PPHs.[256] Similarly, following more than a decade of increased funding to primary care in NZ, leading to reported improved access, Milne et al. found no long-term reductions in PPHs.[257] When examining these results through the lens of the access research discussed earlier in this chapter, it is perhaps easier to understand why, in the face of increased availability of primary care, these researchers found no apparent decrease in rates of PPHs.

If we accept that access can be seen as the degree of 'fit' between the patient and the healthcare service,[225] and that '*the proof of access is use of service, not simply the presence of a facility*',[216(p.111)] then it is perhaps not surprising that better supply of primary care services alone did not appear to have an impact on patient-perceived access to care, as measured by rates of PPHs. Milne and colleagues' findings noted increased PPHs by those who lived in the most deprived quintiles and also for residents who were 'non-white'.[257] Similarly, Falster's study found sociodemographic factors to be one of the main drivers of PPHs.[256] In the domains of access, as proposed by Levesque et al.,[228] the ability to perceive the need for care, the ability to seek and reach care, and the ability to engage with a care provider are all

prerequisites for patient-perceived access to be acceptable.[228] It is likely that the ethnically diverse[257] and economically deprived [256, 257] patients who continued to experience PPHs in the above studies, in spite of increased supply of GPs, did not perceive that their access to care had improved, if no improvements had been made to domains outside of primary care being more affordable and physically available. As stated by Gulliford and colleagues, *'access measured in terms of utilisation is dependent on the affordability, physical accessibility and acceptability of services and not merely adequacy of supply'*.[221(p.186)]

The idea that increased supply of primary care alone is not enough to improve patient-perceived access to care was probably best expressed by health care leaders in another American study. Ricketts et al.[258] undertook regression analysis to investigate the relationship between PPHs and structural or geographical availability of primary care. Results showed a significantly positive correlation between physician supply or availability of a subsidised clinic and admissions for PPHs for those aged ≤ 65 years, specifically related to per capita income and percentage non-white. They inferred that PPHs are an indication of access to care related to income, employment and race.[258] As part of their study, Ricketts and colleagues presented their results to area health leaders, who observed that

> the reality of reducing relative higher rates of PPHs would require more than structural improvement in the primary care system; it would necessitate more fundamental changes in professional behaviour and interventions in the general economy and educational system. [258(p.36)]

The above quotation indicates that these health leaders had real insight into the meaning of patient-perceived access to care, as described in the domains of access,[228] and that it is necessary to address more than physician supply if there is to be any possibility of having an impact on patient-perceived access to care, and thereby reducing PPHs.

5.6.4 Prioritising research into potentially preventable hospitalisations

Recognising that increased hospital admissions were placing pressure on healthcare services and budgets around the world, in 2010 a group in the UK used a modified Delphi approach to (i) establish which PPHs should be prioritised for future research, and (ii) determine which interventions were most likely to reduce hospital admissions.[259] The group developed a web-based questionnaire, based on (i) conditions commonly accepted as potentially avoidable,

identified through a literature search, and (ii) the top 12 PPHs in terms of resource use in South West England in 2005-06. Interventions for PPHs were also identified through a search of the literature.[259] The Delphi panel consisted of GP's, community matrons, out-of-hours and ED clinicians, admitting hospital clinicians and commissioning staff from primary care trusts. Fifty-five participants were involved in both rounds of the Delphi.[259]

There was a high degree of consensus from the panel around the ability to prevent admissions for: dementia (currently not a condition considered Ambulatory Care Sensitive (ACS)), COPD, kidney and urinary tract infection (UTI), cellulitis, abscess and phlebitis, chest infection, pneumonia and influenza in adults, and CCF. When looking at interventions most likely to result in reduced hospitalisation, the highest ranked aspects were all related to improved access to admission alternatives such as community geriatric services, followed by service organisational factors such as chronic disease clinics or access to 'same-day' diagnostic tests.[259]

The above research provides further validity for the use of PPHs as an indicator of access to care. As with the international groups discussed earlier,[245-248] this group of clinical experts, experienced in managing patients with conditions deemed ACS, both in the community as well as the hospital setting, agreed that these conditions could be better managed in community care settings, thereby avoiding hospital admission. Purdy and colleagues' findings go one-step further than the other studies, however, as they clearly show that clinicians with expert knowledge of this cohort of patients agree that improving access to other forms of care in the community is the intervention most likely to be successful in reducing PPHs.[259]

5.6.5 Initiatives to reduce potentially preventable hospitalisations

Reported successes at reducing PPHs by specifically targeting interventions at improving access to care outside of acute care services provide further evidence that rates of PPHs are an acceptable measure of patient-perceived access to care. For example, continuity of care with a preferred GP has been shown to reduce ED presentations among the elderly,[213, 214] as well as reducing PPHs.[260, 261] Similarly, providing higher quality management of diabetes in primary care has been shown to reduce short-stay hospital admissions.[262] Cochrane reviews into hospital avoidance strategies that improve access to care for patients with chronic conditions have reported significant reductions in hospitalisations for patients with CCF and COPD using case management,[263] and integrated disease management programs (i.e.

coordinated multidisciplinary management).[264] Whilst it is not the intention to provide a complete review of the literature on interventions to reduce PPHs, the next section will give some examples of interventions that have been successful at reducing PPHs for patients with chronic conditions by improving access to care.

Providing new models of care delivery have shown some success at reducing rates of PPHs. A group in America that introduced a new health delivery model, with the initial aim of reducing PPHs for patients with diabetes, reported reductions in both hospitalisation and mortality of these patients after two years, compared with matched controls.[265] Primary care physicians were given the option of referring elderly patients ($\geq$ 65 years) with chronic conditions to an on-site nurse care manager. The model proved so successful it was branded 'Care management Plus' and has since been implemented in 420 primary care clinics.[265] One registered nurse, a care manager, identified a key benefit of early recognition of patients who would benefit from the new model, that benefit being the ability to avoid unnecessary hospitalisation due to deterioration: '*a patient that needs some extra help may not be high acuity at the time, but if they don't get an intervention they are going to be'*.[265(p.4)]

Similarly, although not specifically set up to reduce PPHs, the Guys and St Thomas's Trust in the UK has achieved success in reducing avoidable hospitalisations from some conditions, including COPD, CCF, UTI and diabetes, through the provision of a 'Hospital-in-the-home' model of care.[266] The service accepts referrals from GPs and hospitals in the trusts jurisdiction and employs a multi-disciplinary team approach to providing short-term management of patients' in their own home.[266] Among other benefits, Lee and Titchener reported reductions in both ED presentations and inappropriate hospitalisations.[266]

Likewise, a group in New South Wales (NSW), Australia designed a program to improve coordination and integration of services for older people with chronic and complex health issues.[267] The groups aim was to reduce unnecessary hospital readmissions by improving the referral process to medical specialists and other community health services. The program was situated in a socioeconomically disadvantaged area in NSW and involved the patient being at the centre of their care with a GP liaison nurse coordinating care between various providers, organising multidisciplinary case conferences and ensuring accurate information about the patient was provided to the GP or case manager (Fig.5.5).[267] Over a 12-month period, HealthOne Mt Druitt reported significant reductions in the average number of ED

presentations per patient, the average time patients spent in the ED and the average time admitted patients spent in hospital.[267]

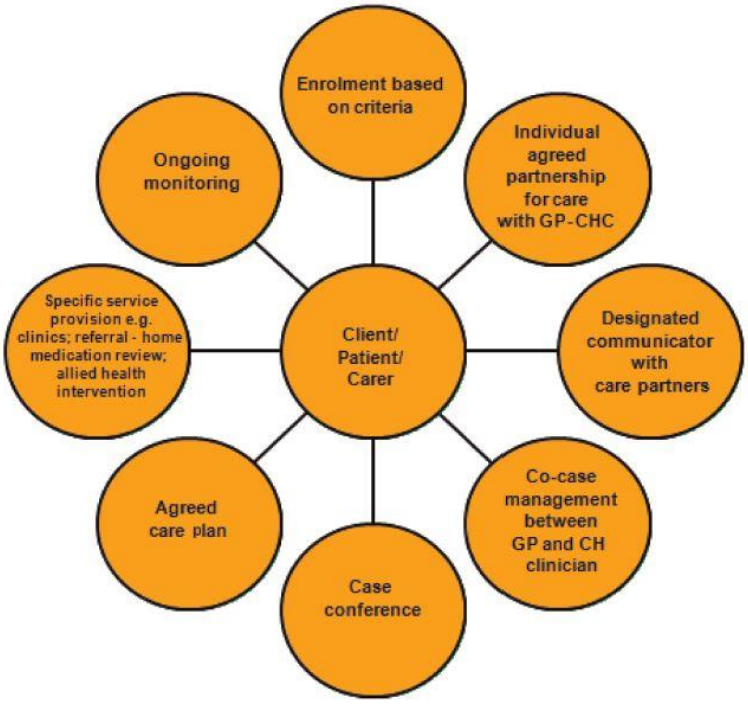

Figure 5.5 HealthOne Mt Druitt key service pathway elements[267]
CH= community health

Considering the above interventions with the domains of access in mind, it can be seen that, although different strategies were implemented, in different environments, these three initiatives have been successful in reducing PPHs by improving patient-perceived access to care. The domain of approachability and the ability to perceive the need for care[228] was addressed by the outreach nature of all three projects, where clinicians were encouraged to refer early to appropriate services, before the patient deteriorated and required a hospital admission. Similarly, the domain of appropriateness and the ability of the patient to engage with required services[228] was addressed by the provision of a health care worker to coordinate and navigate the complicated system to ensure the patient received the right service, at the right time, and in the environment most suited to the patient. Once again, the success of these initiatives can be taken as providing further validity to the use of PPHs as a measure of patient-perceived access to care.

5.7 Chapter summary

This chapter has provided an overview of the research into patient-perceived access to healthcare. Definitions of access to healthcare spanning five decades were provided, as well as a brief overview of the development of the domains of access. Potential barriers faced by individuals trying to access required services and some consequences to unrealised access were discussed. Particular groups identified as more likely to encounter barriers in accessing required care were identified (i.e. those living in rural areas and/or socially isolated). Likewise, research highlighting obstacles to realised access to healthcare in the Australian context were presented. Following the discussion on access itself, the importance of measuring access to care, particularly from the user's perspective, was discussed. Evidence was provided regarding the development of a group of conditions considered amenable to management in the ambulatory care setting (PPHs), as well as the validity of the use of PPHs as a measure of patient-perceived access to care.

The current model of care, in which patients with chronic diseases often experience frequent hospital admissions for exacerbations of one condition, only to be discharged without consideration of the impact of that admission on their other chronic health issues is untenable in the current climate of increasing costs of health care, the ageing population and increases in the prevalence of chronic disease. There have been calls upon the Australian government to reform current models of care for patients with chronic conditions.[268] Understanding how the healthcare system works, from the patient's perspective, is critical in informing policy decisions about the future of health care services. As this chapter has illustrated, PPHs are a valid measure of patient-perceived access to care outside of the acute sector. Therefore, the following section of this thesis will involve an analysis of six-years of inpatient data at one Australian hospital to investigate the hypothesis that patient-perceived access to care, as measured by PPHs, is one factor driving the increase in ED presentations and subsequent hospitalisations of patients aged ≥ 75 years.

Chapter 6. Emergency department crowding in Tasmanian: the role of potentially avoidable admissions

"The goal is to turn data into information,
and information into insight."
– Carly Fiorina

This chapter was peer-reviewed and presented as an oral presentation at the 6th Annual International Conference on Worldwide Nursing in Singapore in July 2018. The paper in its entirety was printed in the conference proceedings. The final Word version of the completed manuscript in included here, with references listed at the end of this thesis. A PDF of the published manuscript is included in the appendices (appendix (vii)).

Patient-perceived access to care is a driver of increased emergency department presentations by the elderly

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Chapter 7. Factors driving the increase in emergency department presentations and short-stay hospital admissions for elderly patients with congestive cardiac failure

"Discovery consists of seeing what everybody has seen,
and thinking what nobody has thought."
— Albert Szent-Gyorgi

7.1 Introduction

Phase one of this research project (Chapter four), identified a statistically significant increase in per capita ED presentations at the RHH by those aged ≥ 75 years (increasing at a rate of 12.5% per annum, 95% CI 5.8 - 19.2) over a four-year period. Furthermore, approximately 70% of all patients aged ≥ 75 years who presented to the RHH ED were admitted, compared with approximately 25-30% for younger patients.

Phase two (Chapter six) identified a 21% increase in all PPHs at the RHH over a six-year period, versus a 1.7% increase in non-PPHs. PPHs by those aged ≥ 75 years increased by 24%, (a 10% increase in per capita PPHs), whereas non-PPHs for this population increased by 18%. Short-stay PPHs accounted for 51% of all PPHs for patients aged ≥ 75 years and increased by 70%, compared to a 27% increase in short-stay PPHs for those aged < 75 years. CCF accounted for the greatest percentage of all short-stay PPHs in those aged ≥ 75 years (21%) and increased by 174% (54 to 148) over the time-period.

In essence, phases one (Chapter 4) and two (Capter 6) of this research project identified a disproportionate increase in ED presentations and subsequent short-stay hospital admissions by elderly people with CCF in one Australian region. The international literature is clear that continued increases in ED presentations and emergency admissions is unsustainable. To gain a better understanding of the factors driving this trend in our region, we decided to examine more closely the short-stay CCF admissions by elderly patients identified in phase two. We were particularly interested in ascertaining whether perceived access to other forms of care and/or increased patient acuity played a role in increased

admissions. Therefore, we decided to undertake an audit of the DMRs of the 175 patients who accounted for the 202 short-stay admissions for CCF at the RHH in the years 2010-11 and 2015-16. Phase three of this project set out to answer the research question, *What are the patient and/or system factors driving the increase in ED presentations and short-stay hospital admissions for elderly patients with CCF?* The aims of phase three were: (i) to identify changes over time that might highlight factors contributing to the increase in ED presentations and subsequent short-stay admissions of this cohort of patients, including access to primary care and/or increased severity of condition, and, (ii) to build a profile of the types of patients experiencing short-stay hospital admissions for CCF in this patient demographic.

This chapter will discuss the growing burden of chronic disease in Australia. A brief overview of CCF will be provided, including its prevalence and incidence, symptoms, severity classification and management. Subsequently, a description of the methods and results of the DMR audit of the 50 patients who experienced 54 short-stay CCF admissions in 2010-11 and the 125 patients who experienced 148 short-stay CCF admissions in 2015-16 will be given. Finally, a discussion of the audit results with reference to current literature on CCF management will complete the chapter.

7.1.1 Chronic disease

As identified in Chapter 3 of this thesis, elderly patients with complex and chronic illness have been identified as an emerging driver of ED crowding.[284] Chronic diseases are the leading cause of death and ill health in Australia,[237] and the world.[285] Changes in lifestyle and reductions in other diseases, as well as better treatment and management of chronic conditions, have led to the increased burden of chronic conditions being identified as one of the factors driving an increased demand for health services and rising health expenditure.[237] Acknowledging that chronic conditions were, *threatening to overwhelm Australia's health budget,*[286(p.9)] COAG collaborated in 2017 to develop a national framework for chronic conditions with the shared vision that *all Australians live healthier lives through effective prevention and management of chronic conditions*.[286(p.14)]

Almost half (47%) of all PPHs in Australia in 2014-15 was for patients with chronic conditions; however, there was substantial regional variation in rates of hospitalisation for many conditions.[287] In 2014-15, more than 11 million Australians (50%) had one of eight selected chronic diseases (arthritis, asthma, back pain and problems, cancer, cardiovascular

disease (CVD), COPD, diabetes and mental health conditions).[237] The rate was higher for people aged ≥ 65 years, those living in the lowest socioeconomic areas, and those living in regional and remote areas.[237] Many chronic disease sufferers have comorbidities, that is, suffer from two or more chronic diseases at the same time, leading to complex issues in the management of each individual condition. Twenty-nine percent of Australians aged ≥ 65 years reported having three or more chronic conditions in 2014-15.[237]

In 2014-15, the most common self-reported chronic diseases in Australia were CVD (18%) and mental health conditions (18%), with CVD being the most common reported chronic condition for those aged ≥ 65 years.[237] CVD is a collective term for diseases of the heart and blood vessels, including coronary heart disease, stroke and heart failure (HF).[288] It is the leading cause of death in Australia,[289] with 29% of all deaths in 2015 having an underlying cause of CVD.[288] In terms of Australian spending on admitted patient care, CVD is consistently responsible for the most expenditure, with an estimated $5 billion or 11.1% of total admitted patient expenditure related to CVD in 2012-13.[237] As Australia's population in 2061 is projected to increase to between 36 and 48 million people, with around 22-24% being 65 years or older,[290] the burden in terms of health expenditure on CVD management is likely to increase exponentially.

7.1.2 Congestive cardiac failure

[iv]CCF, '*the inability of the heart to provide adequate circulation*',[291(p.8)] is responsible for much of the burden of CVD in Australia.[292] CCF can occur secondarily to a range of causes, including coronary heart disease, MI, and hypertension.[293] The prevalence of CCF is estimated at 1-2% of the Western world, with the prevalence increasing with age,[294] and it is estimated to affect 10% of the population aged ≥ 75 years.[295] Although there is limited Australian data on the incidence of CCF,[292] the AIHW estimates that Australia has 30,000 new cases of CCF diagnosed each year.[296] Locally, Tasmania has an estimated 1,800 new cases of CCF diagnosed annually in adults aged ≥ 45 years, with CCF admissions accounting for 28,000 days of hospital stay at a cost of $52.4 million (2017).[297]

Patients with CCF experience multiple symptoms including breathlessness, fatigue, peripheral oedema, loss of appetite, confusion and depression.[293, 294, 298] The severity of CCF

[iv] In the literature, the acronyms CCF and CHF are used interchangeably. For the purposes of consistency, CCF will be used throughout this thesis

symptoms is generally classified according to the New York Heart Association (NYHA) grading system (Table 7.1).[291]

Table 7.1 NYHA grading of symptoms in CCF.

Class I	*No limitations. Ordinary physical activity does not cause undue fatigue, dyspnoea or palpitations.*
Class II	*Slight limitation of physical activity. Ordinary physical activity results in fatigue, palpitation, dyspnoea or angina pectoris (mild CCF)*
Class III	*Marked limitation of physical activity. Less than ordinary physical activity leads to symptoms (moderate CCF)*
Class IV	*Unable to carry on any physical activity without discomfort. Symptoms of CHF present at rest (severe CCF)*

National Heart Foundation of Australia[291]

Prognosis is poor,[292, 295] with 20-30% of Australians with mild to moderate HF and 50% of those with severe HF dying within one year.[292] Due to the poor prognosis, including the risk of sudden cardiac death, the inclusion of discussions on palliation as part of the patient and carer education process is recommended.[291, 299, 300] The goals of treatment centre on symptom management, prevention of hospitalisation and improving quality of life.[298, 300, 301] Along with lifestyle modifications and pharmacological therapies, patient education and self-management is considered *'critical'*[291(p.21)] for improved outcomes.[300, 301] Essential aspects of patient education include ensuring the patient and their carer have a good understanding of the pathology and treatment of CCF, and the significance of adhering to all treatments, both pharmacological and non-pharmacological, as well as the importance of monitoring their condition and recognising when to seek medical help.[291, 298, 301] In some cases, patients may be given discretion to increase the dose of their diuretic therapy in response to identified changes in their condition,[298, 300] thereby potentially avoiding a hospital admission.

Although one of the recognised goals of management of patients with CCF includes the prevention of hospitalisation, approximately 70% of the total health care cost of CCF in Australia is related to the cost of hospitalisation.[291] It is has been suggested that up to two-thirds of CCF-related hospitalisations are preventable.[291] Phase two of this project identified an 8.5% annual average increase in the hospitalisation of patients aged $\geq$ 75 years with CCF, over a six-year period, with a 174% increase in short-stay admissions.[302]

The next section will present the methods and results of a DMR audit of the 175 patients (202 admissions) who experienced a short-stay admission at the RHH for CCF in the years 2010-11 and 2015-16. The two time periods allowed a comparison to examine potential temporal changes (e.g. in disease severity) that may have contributed to the observed increase in ED presentations and short-stay admissions.

7.2 Method

7.2.1 The data

All patients who attend or are admitted to the RHH have their clinical notes coded and scanned to the DMR within 21 days of discharge. Each patient has a unique patient identification number. The DMR contains scanned copies of inpatient and outpatient clinical notes, observation charts, ambulance records, correspondence and results of investigations. Clinical staff have access to a patient's DMR when using a THS computer terminal. A data manager oversees the DMR system and regularly undertakes audits to ensure accuracy of the data and identify any possible misuse. As per ethics requirements at the University of Tasmania, data custodian permission to access the DMRs was sought prior to commencement of the study. We were granted approval to access the DMRs of patients aged ≥ 75 years who had experienced a short-stay CCF admission in the years July 1st 2010 to June 30th 2011 or July 1st 2015 to June 30th 2016.

7.2.2 Data extraction

A purposefully designed, paper data extraction tool was developed (appendix (viii)).[303, 304] Patients were eligible for inclusion in the audit if they were aged ≥ 75 years and had experienced a short-stay admission for CCF at the RHH in the years July 1st 2010 to June 30th 2011 or July 1st 2015 to June 30th 2016. Each eligible patient's DMR was accessed and data extracted relating to their short-stay admission. If patients had experienced more than one short-stay CCF admission in the same year this was treated as a separate admission for the purposes of the analysis. Extracted data included:

- Demographic details: age, gender, marital status, living circumstances (living alone, Residential Aged Care Facility (RACF)), postcode, mode of presentation (ambulance, private transport), reason for presentation (e.g. pulmonary oedema secondary to CCF), in-hospital mortality, discharge destination

- Patient attempts to access other forms of care in the week before attending the ED (e.g. primary care), where documented
- Visits to the ED during the previous 12 months
- CCF-related ED presentations in the previous 12 months
- CCF-related hospital admissions in the previous 12 months (LOS > 2 days)
- All hospital admissions during the previous 12 months
- Comorbidities
- Medications
- Levels of acuity (CCF severity) as measured by:
    - The New York Heart Association (NYHA)[291] index, and
    - Left Ventricular Ejection Fraction (LVEF),[291] if documented

A random audit of 10% of all extracted data was undertaken by a second researcher to ensure accuracy of data extraction.[303, 304]

7.2.3 Data analysis

All extracted data were entered into, and managed within, Statistical Package for the Social Sciences (SPSS version 24) software. A random audit of 10% of the data entry was undertaken to ensure accuracy of data entry.[303] Data were grouped into two cohorts by time period; cohort one, 2010-11 and cohort two, 2015-16 – to allow for comparison between the two time periods. Descriptive statistics were used to assess changes over time. Numbers and types of comorbidities were recorded to enable the building of the profile of these patients and to test for change in disease severity. Independent t-tests, chi square tests and Mann-Whitney U tests were performed, as appropriate, to test for significant differences between the two cohorts. Details of any attempts to access other forms of care were extracted to assess whether the admission could have been potentially prevented if more timely care had been provided in the community, and to identify any changes to health service usage over time. Details of previous CCF-related ED presentations and hospital admissions were extracted to identify changes in access to acute care. Changes to levels of condition acuity were assessed by extracting NYHA indices and LVEF percentages for each admission, where documented.

Phase three of this project to extract data from patient's medical records was approved by the Human Research Ethics Committee of the University of Tasmania (reference number H16698 (appendix (ix)).

7.3 Results

The audits of both the data extraction and the data entry showed 100% agreement.

7.3.1 Summary of admissions: 2010-11 and 2015-16

There were 54 short-stay admissions for CCF by 50 patients aged ≥ 75 years to the RHH in the year July 1st 2010 to June 30th 2011. One of these admissions was not scanned into the DMR database, leaving 53 admissions available for inclusion in the audit. The majority (90%) had one short-stay CCF admission in the year, whilst four patients had two short-stay CCF admissions (Table 7.2). There were 148 short-stay admissions for CCF by 125 patients aged ≥ 75 years to the RHH in the year July 1st 2015 to June 30th 2016. All of these admissions were correctly scanned into the DMR database, leaving all 148 admissions available for inclusion in the audit. The majority (83%) had one short-stay CCF admission in the year, whereas 18 patients (14%) had two short-stay CCF admissions and three patients experienced three short-stay CCF admissions in the year (Table 7.2).

7.3.2 Comparison of health service usage of short-stay CCF admissions: 2010-11 and 2015-16

The cohort of short-stay admissions for CCF in 2010-11 were not found to have greatly different patterns of health service usage prior to ED presentation than the cohort in 2015-16. Similar proportions were referred to the ED by their GP, saw a health care professional in the week prior to ED attendance, and had attended the ED in the previous 12-months (Table 7.2). The decrease in LOS from 2-days to 1-day in the latter cohort was marginally significant (Table 7.2).

Table 7.2 Comparison of health service usage of all ^short-stay #CCF admissions by patients aged ≥ 75 years to the *RHH: 2010-11 and 2015-16.

Variable *n* = number of admissions in year	2010-11 (*n* = 53) (%)	2015-16 (*n* = 148) (%)	Test of significance	βResult (p)
Referred by GP	14 (26)	34 (23)	Chi Square	0.614
Saw a ‡HCP in week prior to this admission	20 (37)	53 (36)	Chi Square	0.804
Mode of arrival to ED:			[a]Chi Square	0.762
• Ambulance	45 (85)	123 (83)		
• Private transport	7 (13)	18 (12)		
• Other	1 (1.9)	7 (4.7)		
Length of stay 1 day	26 (44)	94 (64)	[b]Chi Square	0.066
Attended ED in preceding 12 months	30 (56)	89 (60)	Chi Square	0.654
Number of short-stay #CCF admissions in each year:			[c]Chi Square	0.144
• One	49 (92)	127 (86)		
• Two	4 (7.5)	18 (12)		
• Three	0	3 (2.0)		
Number of ED presentations in preceding year	76	218		
Median	1	1	Mann-Whitney U	0.725
¥IQR	0 – 2	0 – 2		
Number of admissions post-ED presentation in preceding year	61	177		
Median	1	1	Mann-Whitney U	0.650
IQR	0 – 2	0 – 2		
Number of CCF-related ED presentations in preceding year	51	123		
Median	0	0	Mann-Whitney U	0.809
IQR	0 – 2	0 – 2		
Number of CCF-related admissions in preceding year	49	120		
Median	0	0	Mann-Whitney U	0.971
IQR	0 – 1.5	0 – 2		

^Length of stay ≤ 2 days #Congestive Cardiac Failure *Royal Hobart Hospital βStatistical significance = p < 0.05
‡Health care professional ¥Interquartile range

a Ambulance versus aggregate of private transport and other
b 1 versus 2 days
c 1 visit versus >1 visit
Some totals = < 100% due to missing data and/or rounding

7.3.3 Comparison of patient and disease profiles of short-stay CCF admissions: 2010-11 and 2015-16

The cohort of short-stay admissions for CCF in 2010-11 did not differ greatly from the cohort in 2015-16. The mean age was unchanged, as were the median number of comorbidities (Table 7.3). Similar proportions were emergency admissions, were triaged as high acuity (ATS 1-3) and died within 12 months of the short-stay CCF admission (Table 7.3).

Table 7.3 Comparison of patient and disease profiles of all ^short-stay #CCF admissions by patients aged ≥ 75 years to the *RHH: 2010-11 and 2015-16.

Variable ***n* = number of admissions in year**	**2010 -11** **(*n* = 53)** ***n* (%)**	**2015-16** **(*n* = 148)** ***n* (%)**	**Test of significance**	**βResult (p)**
Gender: Male	32 (60)	68 (46)	Chi Square	0.071
Age in years (Mean)	83.8	83.8	t test	0.997
¥SD	5.3	5.7		
Allocated ATS:			Chi Square	0.482
• 1-3	45 (85)	121 (82)		
• 4&5	7 (13)	18 (12)		
Type of admission:			[b]Chi Square	0.181
• Emergency	52 (98)	138 (93)		
• Palliative	1 (1.9)	8 (5.4)		
• Elective	0	1 (0.7)		
• Other	0	1 (0.7)		
Marital status:			[c]Chi Square	0.880
• Married	21 (40)	62 (42)		
• Single	2 (3.8)	10 (6.8)		
• Widowed	27 (51)	54 (36)		
• De Facto	2 (3.8)	4 (2.7)		
• Divorced	0	17 (11)		
• Other	1 (1.9)	1 (0.7)		
Living status:			[d]Chi Square	0.229
• Alone	14 (26)	56 (38)		
• With spouse	21 (40)	54 (36)		
• Other family member	7 (13)	10 (6.8)		
• πRACF	7 (13)	19 (13)		
• Other	3 (7.4)	6 (6.1)		
Discharge destination:			[e]Chi Square	0.976
• Usual place of residence	40 (75)	112 (76)		
• Died this admission	9 (17)	18 (12)		
• Other health care facility	3 (5.7)	11 (7.4)		
• Other ward	0	5 (3.4)		
• Other	1 (1.9)	2 (1.4)		
Number of comorbidities (Median)	3	3	Mann-Whitney U	0.760
¥IQR	2 – 3	2 – 4		
Died within 12 months of this admission	25 (47)	66 (45)	Chi Square	0.747

^Length of stay ≤ 2 days #Congestive Cardiac Failure *Royal Hobart Hospital βStatistical significance = p < 0.05
¥Standard deviation πResidential Aged Care Facility ¥Interquartile range

b Emergency versus aggregate of palliative, elective and other
c Aggregate of married and de facto versus aggregate of single, widowed, divorced and other
d Aggregate of with spouse and other family member versus aggregate of alone, aged care facility and other
e Usual place of residence versus died this admission, other health care facility, other ward and other
Some totals = < 100% due to missing data and/or rounding

7.3.4 Level of acuity and medication management

When reviewing the patient medical records, it became clear that the NYHA index and details of LVEF +/– other results of echocardiograms were not commonly recorded. For example, in

2010-11 only 7 admissions (13%) had an echocardiogram, which increased to 44 admissions (30%) in 2015-16, making a meaningful comparison between the two cohorts impossible. Therefore, it was agreed with the research team that these variables would not be extracted. Similarly, the team agreed that, as there were many reasons a particular patient may or may not be prescribed recommended medications for their CCF (e.g. drug interactions, intolerance, patient preference), details of medications would not be extracted.

7.3.5 Reasons for this presentation to the ED

The most common documented reason for presentation to the ED in both time-periods was shortness of breath (SOB), either on its own or in combination with chest pain or oedema. SOB on exertion was the next most common reason for all presentations. When all presentations with SOB documented as one of the reasons for ED attendance were analysed, SOB accounted for 68% of ED presentations in 2010-11 and 60% of presentations in 2015-16. Other presenting symptoms included cough, confusion, feeling unwell, chest pain alone or collapse/cardiac arrest.

7.4 Discussion

The main result of this DMR audit was that, although there had been a 174% increase in short-stay CCF admissions by those aged $\geq$ 75 years at the RHH from 2010-11 to 2015-16, the profile of these patients has not changed over time. The mean age was unchanged, as was the median number of comorbidities. Similarly, the ways in which these patients accessed the system had not changed, with comparable proportions documented as having contacted a health care professional in the week prior to admission and arriving at the ED via ambulance. However, in terms of health service significance, 142 more ED presentations resulting in 116 more hospital admissions in a single year, by people in this age demographic, clearly place a large burden on the healthcare system in terms of resource use.

Results of this audit did not identify an obvious explanation for the 174% increase in short-stay CCF admissions in these older patients. However, as reported in Chapter 6 of this thesis, the proportion of all CCF admissions by those aged ≥ 75 years that resulted in a short-stay admission increased from 29% to 53% over the six-year period (Fig. 6.4). Likewise, the DMR audit found that even amongst short-stay CCF admissions, the proportion whose LOS fell from 2 days to 1 day increased by 20% over the six-year period (Table 7.2). Perhaps this shorter LOS, whereby patients are potentially discharged before returning to optimal levels of

wellness, is one explanation for the identified increases in representations to the ED and subsequent readmissions.

7.4.1 Length of stay

Nationally,[305] and internationally[306] it has been reported that the LOS following emergency admission has been decreasing. An increase of 92% in the number of same-day/overnight admissions over a ten-year period was reported by one Australian group, whereas multi-day admissions rose by only 15%.[305] The Australian study also found that patients aged ≥ 75 years were 5.1 times more likely to be admitted for a same day/overnight admission than patients aged 35-59 years, and that in the final year of the study (2008-09), 23% of all same-day/overnight admissions were for patients aged ≥ 70 years.[305] Given the projected growth in the elderly population, Lowthian et al. recommended that out-of-hospital models of care be explored for this patient population.[305] Conversely, a UK group reported that their identified increase in short-stay emergency admissions was not concentrated in any particular age band, nor diagnostic category, leading them to speculate that the increase may be related to a lack of alternative services.[306] Blunt and colleagues recommended that policy makers work to better understand the contribution of inadequate out-of-hospital care on emergency admissions, and aim to promote more coordinated care.[306]

The literature investigating the impact of reduced LOS on patient outcomes, including readmissions, provides mixed results. A large observational study that investigated the effect of reduced LOS on outcomes for elderly veterans (≥ 65 years) with HF over a 14-year period found that as LOS reduced, 30-day readmission rates increased significantly.[307] Bueno and colleagues proposed that in an effort to reduce hospital costs, patients with HF may be discharged too early and argued that this initiative was in fact a false economy, when the increase in readmission rates were considered.[307] An American study that investigated trends in readmission rates over a seven-year period for patients with one of six conditions (MI, CCF, gastrointestinal haemorrhage (GIH), COPD, pneumonia and stroke) found that reductions in LOS had no adverse effect on participants with five of the six conditions. However, they did report a significant 15% increase in the risk-adjusted all-cause readmission rate for patients with CCF.[308]

Conversely, a more recent observational study conducted over 14 years in 129 Veteran Affairs hospitals in the US, reported a signification reduction in 30-day all-cause readmission

rates for medical patients in line with reductions in LOS.[309] Although admissions for all conditions showed reductions in LOS, only the reductions in LOS for patients with COPD (4.5% of the study population) were statistically significant.[309] Likewise, a Canadian before-after study that measured the effect of a care transformation initiative that resulted in significant reductions in LOS for medical patients, reported no increase in 30-day all cause readmission or ED visits in the 12 months following the introduction of the initiative.[310] Interestingly, of the two studies that reported significant increases in readmissions, one focussed solely on patients whose index admission was for CCF,[307] and the other reported that the significant increase in readmissions was only for patients whose index admission had been for CCF, and not for the other five conditions studied.[308] The mean age of participants with CCF in these two studies was 80 and 78 years, respectively.[307, 308] However, the two studies that reported no negative impact of reduced LOS on 30-day readmissions included all medical patients,[309, 310] and participants had lower mean ages (64 and 65 years, respectively) than participants in the studies showing adverse effects of reduced LOS. Together, the above studies suggest that reducing the LOS for older patients with CCF may have a negative impact on readmission rates.

As this DMR audit found, not only did patients in the later cohort (2015-16) have increased numbers of short-stay CCF admissions in a 12-month period, but they also had increased numbers of all cause ED visits and hospital readmissions (Table 7.2). Although neither of these increases were found to be statistically significant, this is an important finding in terms of increased used of health care resources. More research should be undertaken to specifically investigate the effect of reduced LOS on readmissions for elderly patients with CCF in this region. This research should explore patients' perceptions of their readiness for discharge after a short-stay admission, discharge planning and follow up care, as well as patients' knowledge of the availability of alternatives to the ED for their perceived health care needs.

7.4.2 Impact of ED attendance and hospitalisation on elderly patients

As well as increasing the burden on the healthcare system in terms of resource use, there is evidence to suggest that ED utilisation and subsequent hospitalisation has negative impacts for elderly patients.[283, 311, 312] A systematic review that looked at patterns of ED use and outcomes for older adults found that CCF was one of the most common reasons for older adults to present to EDs, and that older ED users experienced higher rates of adverse events

post-ED presentation than younger users.[313] Identified adverse events included functional decline, risk of readmission and death.[313] Aminzadeh and Dalziel concluded that *'the current disease-orientated and episodic models of emergency care do not adequately respond to the complex needs of frail older adults,'*[313(p. 238)] and recommended action be taken in terms of primary and secondary prevention to reduce the need for elderly adults to attend the ED.[313] One Australian group that identified increased ED utilisation by the elderly in the greater Sydney area as a driver of ED demand, speculated that their finding may be an indicator of suboptimal chronic care, and recommended that a whole-of-healthcare-sector approach be taken to address the issue.[212]

Similar to ED utilisation, unplanned admissions are associated with poorer outcomes for elderly patients.[314] Identified potential negative impacts of hospitalisation on the elderly include increased risk of infection and loss of self-confidence,[315] as well as the potential for delirium, adverse drug reactions and nutritional problems.[311] Although it was outside the scope of this DMR audit to identify negative impacts of short-stay emergency admissions on the study population, the published evidence is clear that continued readmissions can have detrimental effects on this patient population.

7.4.3 Limitations

Although this DMR audit provided a comprehensive overview of the 175 patients aged ≥ 75 years who experienced a short-stay CCF admission at the RHH in 2010-11 and 2015-16, the study is not without its limitations. Including all patients in this age demographic who experienced a short-stay CCF admission in the six-year period would have provided a more complete and informative picture of changes over time. However, the considerable amount of extra time and resources this process would have taken was beyond the scope of this project. As is the case with all audits, it is only possible to study what has been documented. It is possible that the participants in this study had tried to access other forms of care prior to their ED attendance; however, this may not have been recorded. Nevertheless, as the recording of this information is unlikely to have changed over time, it is reasonable to assume that identified trends are accurate.

7.5 Conclusion

The results of this DMR audit identified an increase in all cause ED presentations and hospital admissions in a cohort of patients aged ≥ 75 years at one regional Australian hospital over a

six-year period. Although there were no significant differences identified between the cohort in the final year of the audit (2015-16) compared to the first year (2010-11), proportionately more patients experienced greater than one short-stay CCF admission in the latter year and had a very short LOS of day (1 vs 2 days) in 2015-16. It has been suggested that increased ED presentations by the elderly, leading to crowding, is driven by patients who are older, sicker, and more likely to call an ambulance and go immediately to the ED, thereby bypassing their GP. This audit has identified that, over a six-year period, this was not the case in this region. The audit also identified that the system response to increased admissions by elderly patients with chronic conditions appeared to be limited to reducing LOS in the acute care setting. This finding has implications for policy makers and suggests that new, targeted models of care, specifically aimed at older persons with chronic conditions, could have a positive impact on ED crowding. The findings also suggest that a whole-of-system approach, that focuses on care integration across the acute, primary and community care sectors is warranted, if there is to be any real impact on reducing ED presentations by this vulnerable group.

As research evidence suggests that ED presentations and hospital admissions can have negative impacts on older people, initiatives to combat these identified trends should be undertaken. Understanding the factors contributing to these increases, taking into account the patients' experiences in navigating the healthcare system, could provide insights on potential strategies to alleviate this burden on patients, as well as the healthcare system. Perhaps the time has come to begin investigating patient-level factors, such as providing access to the right services, at the right time, in the right location, in an effort to combat ED crowding, rather than the 'part-of-system' approaches adopted to date.

7.6 Chapter summary

Phase three of this research project aimed to identify the patient and/or system factors driving the identified increase in ED presentations and short-stay hospital admissions for elderly patients with CCF at one regional hospital. The DMR audit identified an increase in all-cause ED presentations and hospital admissions in the final year of the study (2015-16), compared to the first (2010-11). However, no significant differences in terms of patient demographic or disease profile, or in how the elderly utilised the system were identified. Therefore, in an effort to explain the quantitative findings, the decision was taken to prospectively recruit a sample of patients aged ≥ 75 years, who had recently experienced a

short-stay CCF admission at the RHH, to try to understand the journey that had led to their recent admission. The following chapter of this thesis will detail the methods and results of a qualitative exploration of the views of elderly patients to better understand the role of patient-perceived access to care in ED presentations and short-stay PPHs in Tasmania.

Chapter 8. The role of patient-perceived access to care in emergency department presentations and short-stay hospital admissions

"If history were taught in the form of stories,
it would never be forgotten."
— Rudyard Kipling

8.1 Introduction

Increased presentations by the elderly with chronic and complex conditions has been identified as an emerging cause of ED crowding.[88, 90, 184, 206, 212] Access to care has been recognised as a potential driver of increased ED utilisation and subsequent hospitalisation of the elderly.[186, 213-215, 316] Access to care has been defined as '*the opportunity to identify health care needs, to seek healthcare services, and to reach, to obtain or use health care services and to actually have the need for services fulfilled.*[228(p. 9)] Levesque and colleagues identified that, as patients with chronic conditions have a major role in managing their own care, it was important that the concept of access incorporate patient-centred perspectives.[228] In essence, patient-perceived access to care relates to an individual's ability to access the right health service at the right time and involves a complicated interplay between service availability, including cost and location, and the individual's understanding of their health care needs and the appropriateness of available services.[220, 222, 225, 270]

In Chapter 6 of this thesis, a retrospective data analysis of six years of admissions to one Tasmanian hospital identified: (i) a 24% increase in PPHs by the elderly, (ii) that 51% of all PPHs by the elderly were short-stay admissions, and (iii) that CCF was the most common associated condition, accounting for 21% of all short-stay PPHs by those aged ≥ 75 years, and increased by 174% over the six-year period.[302] In Chapter 7, a DMR audit of the 175 patients who experienced 202 short-stay (LOS ≤ 2 days) admissions for CCF in the years 2010-11 and 2015-16 revealed that, although the profile of these patients had not changed appreciably over time, there were 142 more ED presentations resulting in 116 more hospital admissions in 2015-16 in this patient demographic. This finding indicates both an increased burden on the healthcare system in terms of resource use, as well as an impost on elderly patients who

could perhaps have avoided a hospital admission if provided with better access to primary care.

The purpose of using a mixed method sequential explanatory design in this study was to use qualitative data to help explain and elaborate on the initial quantitative findings. It was envisaged that the quantitative findings would provide a general understanding of the problem, in this case, identify the factors driving ED presentations in Tasmania. The qualitative component would than help to explain the statistical results by exploring the views of participants in more depth.[86] Consequently, the plan for phase four was to recruit a purposive sample of patients aged ≥ 75 years who had recently experienced a short-stay hospital admission for CCF at the RHH, and undertake semi-structured interviews to try to understand the journey that had led to their recent admission. The aim of phase four was to explore the views of elderly patients to better understand the role of patient-perceived access to care in ED presentations and short-stay PPHs in Tasmania.

8.2 Method

8.2.1 Study setting

The RHH is the tertiary referral centre for the state of Tasmania. It provides acute, sub-acute, mental health and aged care inpatient and ambulatory care services to Hobart and the surrounding areas, as well as many state-wide services, including cardiac and neurosurgery, hyperbaric medicine and neonatal and paediatric intensive care. It has a 24-hour, seven-day-a-week ED that has approximately 60,000 presentations per year. The hospital has 501 inpatient beds and reported 36,682 episodes of admitted patient care in 2015 (most recent data available).[317]

8.2.2 Participant recruitment

We planned to prospectively recruit participants who had been admitted to the RHH, via the ED, with CCF. The Nurse Practitioner (NP) for chronic cardiac care (recruitment nurse) agreed to recruit potential participants. As part of the role, the NP reviews the list of hospital inpatients daily to identify patients admitted with cardiac conditions. This review includes admissions to all wards including cardiology, general medicine, and the short-stay unit, as well as patients within the ED and any ‘outliers’. The planned recruitment process involved the

recruitment nurse scanning all admissions to identify patients aged ≥ 75 years who were admitted for CCF and who, in the recruitment nurses' clinical judgement, were likely to have a short-stay. When potential participants were identified, they would be approached by the NP and given a brief explanation of the study. If they were interested in being involved, consent would be gained (appendix (x)) to pass their contact details onto the PhD candidate (the researcher), allowing the researcher to contact them after discharge. Inclusion and exclusion criteria are detailed in Table 8.1.

Table 8.1 Inclusion and exclusion criteria for recruitment of study participants.

Inclusion criteria	Exclusion criteria
• Community dwelling	• Residential care dwelling
• Acute admission to the RHH via the ED	• Elective admission
• Aged ≥ 75 years on admission	• Aged < 75 years on admission
• LOS ≤ 2 days	• LOS > 2 days
• English speaking	• Non-English speaking
• Emergency admission	• Non-emergency admission
• Primary diagnosis of CCF	• Transfer from another hospital

Following receipt of the signed consent form, the researcher telephoned the potential participant shortly after the patient was discharged. In a short conversation, it was ascertained (i) if the potential participant met all of the inclusion criteria, and (ii) if the potential participant was interested in being part of the study. If the participant agreed to be involved, a date, time and location for the interview, that suited both parties, was arranged.

8.2.3 Sample size

There is considerable debate in the academic literature regarding adequate sample sizes for qualitative interviews.[318-320] Much of the debate focusses around reaching data saturation, defined as *'when there is enough information to replicate the study, when the* [in]*ability to obtain additional new information has been attained, and when further coding is no longer feasible'.* [321(p. 1408)] It has been noted that the point of saturation can be difficult to identify, and it can be seen as a '*rather elastic notion'.*[322(p. 16)] In their review paper, Baker and Edwards asked 14 experts the question, 'How many qualitative interviews is enough?', and concluded that the recurring answer is *'it depends'*.[323] The various experts questioned stated that, 'it

depends' on many issues, including: the breath and scope of the research question, the methodology employed, the heterogeneity of the study population, the availability of potential interviewees and the resources available to the researcher.[323]

Malterud and colleagues proposed the concept of 'information power' to guide adequate sample size for qualitative studies.[324] Similar to the experts in the Baker and Edwards paper,[323] they suggested that sample size is dependent on: the aim of the study; sample specificity; use of established theory; quality of dialogue; and analysis strategy (Fig. 8.1).[324] Varpio and colleagues,[325] who consider data saturation to be a *'thorny concept'*, suggested that qualitative researchers should use the concept of 'information power'[324] as an alternative to data saturation when making decisions regarding sample size. In the current study, the study aim was narrow; the sample was highly specific and therefore expected to be homogeneous; the interview questions were framed around the domains of access to care; the researcher had previous experience interviewing and facilitating focus groups and therefore was likely to enable a high-quality dialogue during the interviews; and analysis was planned to be case-based. Therefore, it was agreed that we would aim to recruit a sample of approximately six participants to explore the concept of patient-perceived access to care and the role it plays in ED attendance by the elderly.

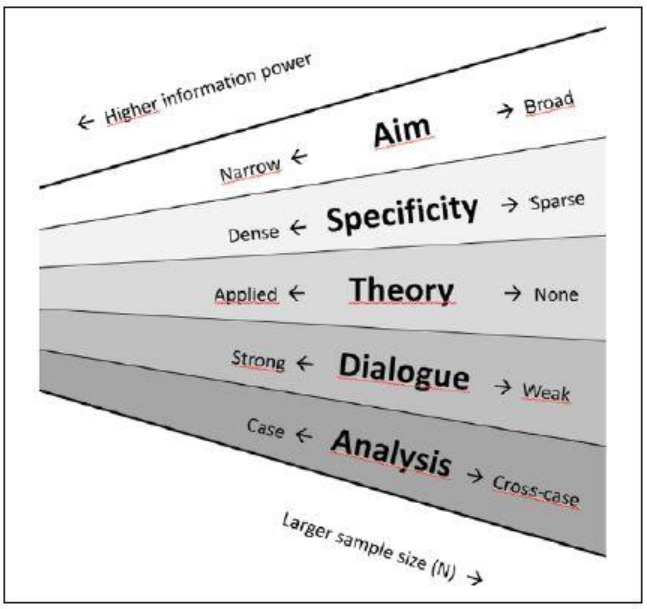

Figure 8.1 Information power – items and dimensions[324]

8.2.4 Data collection

On arrival at the agreed location the researcher began with a general conversation to assist in the building of a good rapport with the participant,[326, 327] and to enable a feeling of trust to develop between the participant and researcher.[209, 326] When the researcher judged that the participant had relaxed, an explanation of the project was given. The participant was given a copy of the participant information sheet (appendix (xi)) to read and keep. The participant was given the opportunity to discuss any concerns and to ask questions to clarify any issues. If happy to continue, the participant was then given two consent forms to sign (appendix (xii)): one to keep and one for the researcher's files. With the participant's consent, the researcher recorded the interview on an audio recorder.

We were particularly interested in the patients' perspectives on their healthcare seeking journey that led to a short-stay hospital admission and whether the admission was in fact avoidable. As the academic literature and our previous research (Chapter 6)[302] had indicated that patient-perceived access to care may be a driver of ED utilisation and subsequent PPHs of the elderly, a question guide structured around Levesque's conceptual framework of access to healthcare[228] was developed (appendix (xiii)), to guide the interview. The interview began with an invitation to the participant to recall their recent short-stay admission and describe, using their own words, the events that led up to the admission. As far as possible the researcher left the participant to talk freely, with minimal interruptions.[326] During breaks in participants' dialogue the researcher offered prompts to expand on the topic, such as '*can you tell me a little bit more about that'*? Throughout the process, the researcher was alert to the comfort levels of the participants and ensured the participants were aware that they could stop the interview and withdraw from the study at any time. At the completion of the interview, the audio recorder was stopped, the participants thanked for their time and the researcher reiterated that the participant could contact her at any time, using the contact number highlighted on the participant information sheet.

8.2.5 Data analysis

The framework approach to data analysis was employed.[328] This approach was developed in the 1980s as a method to analyse qualitative data in applied policy research.[329] It is described as sitting *'within a broad family of analysis methods often termed thematic analysis or*

qualitative content analysis',[330(p. 2)] and is becoming an increasingly popular approach to qualitative data analysis in health service research.[329, 330] An identified benefit of the framework approach is its emphasis on transparency and the links between the stages of the analysis.[328, 331, 332] Pope et al. recommend the use of the framework approach to qualitative data analysis in research where there are pre-set aims and objectives, and the aim is to link the analysis with earlier quantitative findings.[331] A deductive approach to data analysis was used, where code development was guided by the domains of access to care.[228] In contrast to an inductive approach, where themes identified may bear little relation to the questions asked of participants, the deductive approach to data analysis can mean that the data are coded with predetermined themes derived from earlier research.[327, 332]

Interview recordings were sent electronically to a transcription company and transcribed verbatim. Initially, the interview recordings were listened to whilst also reading through the transcripts. In keeping with recommended practices for qualitative data analysis, each transcript was then read and reread to ensure familiarisation with the data.[328, 329] During the familiarisation process, sections of the text were highlighted and notes made in the margins identifying ideas that recurred in the data.[333] The predefined themes were Levesque's five domains of access: 'approachability', 'acceptability', 'availability and accommodation', 'affordability' and 'appropriateness' (see Chapter 5, section 5.3.4).[228] The word 'theme/s' will be used in place of 'domain/s' for the remainder of this chapter. Each interview transcript was coded line-by-line in an attempt to understand participant's meanings. All codes were then mapped to one of the five themes. An 'other' code was also used to ensure we did not ignore data that might not fit under one of the pre-defined themes.[330, 334] A coding matrix was developed, incorporating the themes, direct quotes from the transcripts and initial codes developed by the researcher to reflect the meaning of the participant's words. Thorough checking of the data allocated to each theme was undertaken to ensure that the actual words of the participants were consistent with the meanings of each theme. This involved an iterative process of moving back and forth between the coding matrix, the initial transcripts and the audio recordings. The next step was the categorising of all the data under each theme. Whilst the initial aim was to undertake within-case analysis, several themes emerged across all cases. These are discussed in the results section.

Approval for phase four (patient interviews) of this study was granted from the Human Research Ethics Committee, Tasmania, approval number H0016699 (appendix (xiv)).

8.3 Results

8.3.1 Recruitment

Recruitment for the study commenced in December 2017. Initially, the recruitment nurse reported that, although there were many patients admitted with CCF, they were mostly < 75 years of age or had an LOS > 2 days, and therefore were ineligible to take part in the study. After three months, with no participants recruited, it was decided that the recruitment nurse should consent all patients admitted with CCF in the study age demographic, and the researcher would assess eligibility when potential participants were contacted after discharge. At this stage, one of the hospital cardiology consultants who specialised in CCF was contacted for suggestions on the best way forward re recruiting potential participants. He assured us we were using the best possible strategy. In June 2018 two Clinical Nurse Educators for cardiology agreed to become part of the recruitment team. An amended ethics application was approved, allowing the two new team members to recruit potential participants.

Four participants were prospectively recruited by the nurse recruiters between March and July 2018. Each of the four participants agreed to consent to be contacted by the researcher. All potential participants contacted by the researcher agreed to be interviewed for the study. Due to the advanced age of the participants and therefore potential issues with recall, every effort was made to undertake the interviews as soon as possible after the recent admission. Except for one participant (Ann), who was interviewed 12 days after discharge, interviews took place within five days of discharge. All interviews took place in the participants' homes, with each individual interview lasting approximately 35-40 minutes.

8.3.2 Study participants

All the participants presented as very welcoming, articulate and keen to share their stories. They appeared to have good recall regarding the events leading to their most recent admission. Although one participant did describe some negative experiences (Patricia), she appeared reluctant to share her feelings and defended the clinicians who she felt did not listen to her, by providing assurances that they were probably very busy. A short summary of the demographic profile and history of the short-stay CCF admission for each participant is detailed below. A pseudonym was given to each participant to ensure confidentiality was maintained.

Participant 1. Ann.

Ann is a 78-year-old woman, a widow, who lives alone. She has two daughters who live close by and visit regularly. She described her current medical conditions as COPD, arthritis and a 'heart fibrillation', diagnosed 4-5 months earlier by her GP. She had had one previous ED presentation and admission for *'fluid overload'* in the past 12 months, where she had spent eight days in hospital, had an out-patient appointment with a cardiologist and was then discharged from the clinic. When asked, Ann denied she had CCF.

Her story building up to the most recent admission began a week earlier when she had had a fall at home on her own. She rang the ambulance to help her get up (something she had done once before) but was not taken to hospital. The fall left her with a large bruise on one leg and self-diagnosed bruising of her ribs. Over the course of the week she stated that she developed *'bad fluid retention'* which she thinks may have been related to the bruised ribs. She knew it was fluid retention as the symptoms were the same as her last hospital admission. Eventually, her daughter took her to her GP who advised her to go straight to hospital. Her daughter drove her to the ED. She spent slightly over two days at the RHH and was discharged home with no follow up plans.

Participant 2. Patricia

Patricia is a 75-year-old woman who lives with her spouse. She has neighbours who visit regularly. She described her past and current medical conditions as breast cancer, cardiac failure, a mitral and aortic valve replacement when she was 21 following rheumatic fever as a child, and maybe a respiratory condition for which she takes regular inhalers. She had had one previous ED presentation and hospital admission in the past 12 months. During that emergency admission she underwent surgery for *'bleeding of the stomach and rectum'* that she was told was caused by her medication. She was also fasted for five days in a row for a colonoscopy which never eventuated. She was discharged home after five days with no specific follow-up.

Her story building up to her recent admission began three months earlier (late December) when she was on a cruise in NZ. She noticed her feet began to swell up. On return she developed bleeding which led to the December admission for rectal bleeding described above. Post-surgery she noticed she had *'blown-up like a balloon'* and was told this was due

to the two units of blood she was given in surgery. Following discharge, she saw her regular cardiologist at a pre-planned appointment early in January, who prescribed her a new diuretic tablet. This diuretic helped with the swelling in her legs but not around her stomach, but it also made her very itchy. She tried to contact the cardiologist but *'the number had changed'* and she could not. She saw her GP for her regular warfarin check-up who stopped the new tablet and prescribed her [v]frusemide and spironolactone, and suggested she take these until her next planned appointment with her cardiologist in late March. A week prior to admission she felt herself *'out of breath'* and *'all of a sudden have to take it easy'*. She had another regular GP appointment. On arrival the GP told that her *'pressure'* (indicated jugular pressure) was up and that he would send her to hospital *'for an intravenous drip with the Lasix'*. He wrote her a letter to take with her and advised her to call an ambulance from home. In hospital she had a CT scan after which the doctor told her *'I'm very sorry – I'm not convinced you've got fluid on the lungs'*. Patricia was upset by how she was treated by the medical staff as she felt she wasn't listened to. She was discharged home after two days with no specific follow-up plans. She had a pre-planned appointment to see her cardiologist three days after the interview.

Participant 3. Michael

Michael is an 84-year-old man who lives with his spouse. He has seven children who all live locally and visit regularly. He described his current medical conditions as type 2 diabetes, peripheral vascular disease and rheumatologic disease. He had had no previous ED presentations or hospital admissions in the 12 months prior to his recent admission. When asked, Michael denied having CCF.

His story building up to his recent admission began two to three weeks earlier. He started to feel *'off-colour'* and *'getting shortness of breath'*. He would have to sit in a chair at night to breathe. Eventually his wife suggested he see his GP and, as he was *'feeling lousy'*, he did. His GP did an ECG and called an ambulance. During admission his dose of diuretic was increased. He was told the admission was probably due to his [vi]metoprolol, which was ceased during this admission. The night prior to discharge he had a, *'really bad night'*. The *'nurse heaved me out*

[v] Frusemide and spironolactone are diuretic medications often used in heart failure to decrease fluid (oedema)
[vi] A beta blocker is often used in combination with other drugs to treat CCF. It works by relaxing blood vessels and slowing the heart rate to improve blood flow and reduce blood pressure.

of bed and lean [ed] *me over my table, and propped me up. I just couldn't breathe. It was just a spasm that came…'*. His daughter rang his wife to say she didn't think he should go home but his wife felt *'there's nothing we can do. If they say he's going home, he goes home'*. They did speak to the team in the morning, but Michael felt he was ok. He was discharged home after two days with no specific follow-up. He was discharged with a list of his current medications with changes made on this admission noted. He was aware that *'they are doing a bit of withholding* [of medications] *to see what happens on some of them and stuff'.* He was due for a regular check up with his GP two days after the interview. He had a prearranged cardiology appointment in six weeks' time. He sees this cardiologist annually following a similar admission 18 months ago, although he thinks that that admission may have been for pneumonia.

Participant 4. Brian

Brian is an 89-year-old man, widowed, who lives on his own. He described his past and current medical conditions as type 2 diabetes, cerebrovascular disease and that he has been in the hospital for heart conditions, including having two cardiac stents put in two or three years ago. He is unsure if he has had a heart attack. He had had three previous ED presentations resulting in two hospital admissions in the past 12 months. He was admitted for *'dull pains in my chest'* when *'the heart wasn't getting enough oxygen and blood'*, earlier in the year. He had also had a two-day admission for an ischaemic stroke earlier in the year. Earlier this month he had *'bladder trouble'* and was *'going to the toilet every 10 minutes or something'* so he called an ambulance and was taken to the RHH ED. He was put *'out into one of the green chairs* [waiting room]', and *'sat there and sat there and sat there'*, so decided to go home. When asked, Brian denied having CCF.

His story building up to his recent admission began six days earlier. He developed breathing problems '*I wasn't breathing properly. I was wheezing and whistling noises every time I breathe in especially over the night time'.* He said he was fine during the day with shortness of breath (SOB) only at night. He did see his GP the day after it started. He cannot remember why he saw his GP, but it was a pre-arranged appointment that he thinks was for urinary frequency and dizziness (following his self-discharge from the ED, described above). This appointment was not with his usual GP but another doctor at the practice whom he had not seen before. She commenced him on antibiotics for a urinary tract infection, reduced the dose

of his diuretics (because of dizziness) and told him to return if the SOB continued. On the morning of admission, he awoke early and *'couldn't breathe at all. It was terrible'.* He called an ambulance who *'put something under my tongue'*, and *'put the oxygen thing in my nose'* and then took him to the ED at the RHH. Whilst in hospital he had a chest x-ray, an echocardiogram and his diuretics were *'changed'*. He was discharged home after 2 days with no specific follow-up. He was due for a pre-arranged appointment at his GP three days after the interview.

8.3.3 Coding the data

As described in section 8.2.5 above, a coding matrix was developed, incorporating the themes, direct quotes from the transcripts and initial codes developed by the researcher to reflect the meaning of the participants' words. An example of a coding matrix from one transcript is presented in Table 8.2.

Table 8.2 Example of a coding matrix to identify codes and theme the data.

Theme	Initial coding	Transcript. Brian
AFFORDABILITY	No financial issues	**LN 263.** Bulk Billed
APPROACHABILITY	Knowledge of health/ perceives need for care	**LN 77.** I know now, I'd been having this breathing problem for two or three days
	Knowledge of health/ perceives need for care	**LN 78.** I wasn't breathing properly
	Knowledge of health	**LN 99.** I can put up with heart attacks and all the other, but no, if you can't breathe, it's terrible, that is.
	Beliefs related to health/ knowledge that service can be reached	**LN 103.** I wanted to get to the hospital
	Knowledge of medications/ health literacy	**LN 107.** I'm not too sure anything on here's [written discharge plan] relevant to that. No. I was on these Furosemide tablets, I'm still on those.
	Knowledge of medications/ health literacy	**LN 117**. Attend echocardiogram," I couldn't, I had to cancel that. "Decrease that one to two 20 mil tablets morning only.
	Knowledge of services/ knowledge that service can be reached	**LN 168.** Because that's the best place to go to in these things [ED]. They know what to do, they know all about it and everything
	Knowledge of services/ perceived need	**LN 174.** Well, it wasn't too bad the first time I went to the GP.
	Knowledge of medications/ health literacy	**LN 232.** They [diuretic tablets] help the lungs to get rid of the, or help the heart to get rid of the, what would you call it [fluid]?
ACCEPTABILITY	Knowledge of health care options	**LN 373**. it's where you go [hospital], yeah [when you want it fixed now]
	Knowledge of options/ capacity to choose	**LN 376**. the hospital [for non-routine care].
	Knowledge of options/ Capacity to choose	**LN 337**. I'd ring the ambulance again [in a similar situation], go right in there where the doctors know me
	Lack of knowledge of options	**LN 368**. Well, of course you just can't see a doctor in the middle of the night or middle of the morning.
AVAILABILITY & ACCOMMODATION	Accommodation re appointments and continuity of care/ availability of services	**LN 255.** Mostly, yes [get a same day appointment]. Sometimes hard, especially when I was seeing Doctor [previous doctor], she was very hard to get into it [sic]. But I've had no trouble with getting to Doctor [different doctor, same surgery].

	Accommodation re appointments and continuity of care	**LN 259.** I would possibly get an appointment [today]. Possibly not.
	Ability to physically reach care	**LN 265**. Drives self
APPROPRIATENESS	Capacity and motivation to participate in care/self-management	**LN 58.** Of course I've done my thing [checked blood sugar]….Two or three times a day, blood pressure and temperature.
	Lack of involvement in decisions about care	**LN 184**. I did have doctor order me two x-rays down there of the chest, so I don't know
	Capacity to communicate/motivated to participate in care/ client involvement in decision making	**LN 223**. When the doctor seen me on that particular Thursday morning I said to the doctor, I said, "What dosage of that tablet?" She said, "One a day."
	Health literacy, self-efficacy and self-management/ motivated to participate in care	**LN 226**. Yeah. But because they're not as strong as they were, they told me to take two tablets, because these are different strength.
	Integration of services	**LN 213**. Of course, the hospital gave me a medication list I wanted her [GP] to see, … the hospital will have contacted her [GP].
	Good 'fit'	**LN 315**. I've got a good relationship with the doctors [GPs] down there
	Time spent assessing problem	**LN 86**. they [paramedics] done a lot of work on me here
	Poor interpersonal skills	**LN 138**. The [ward] nurse came and spoke to me but I'm not too sure what it was all about
	Fit between service and client's needs	**LN 246.** because she knows the history now, and [regular GP] doesn't know the history…. well at the present moment I'll see the one that knows the history
	Interpersonal qualities of provider. Good 'fit'	**LN 252.** Oh, God yeah. I don't have to say anything to the staff [at GP surgery], I just go in and they say, "Yeah, go and sit over there," or wherever. They know my name.
	Capacity to communicate/ Health literacy, self-efficacy and self-management	**LN 316**. this thing here [written discharge plan] is very handy Doctor [regular GP] never ever done this for me, give me a letter to do all these things, and I found that very helpful with diet and that.
	Ability to engage in healthcare	**LN 320**. Its good, easy [written discharge plan]. Bring it home and read it
	Good 'fit' good interpersonal qualities	**LN 321**. But I'm quite satisfied with where I am [GP surgery], we get on really well.
	Good interpersonal qualities	**LN 325**. They [staff at hospital] are very caring and I found them exceptionally caring

8.3.4 Affordability

The theme of affordability relates to the client having the economic capacity to spend resources on health care. This includes the time to attend appointments, the price of services and the potential opportunity costs related to lost income when attending appointments. Incorporated in this theme is the ability of the client to generate sufficient financial resources such that paying for health care does not mean catastrophic expenditure relative to the clients' means.[228]

All of the participants stated that they were bulk-billed by their GP and had no issues with the costs related to their health care needs. Two of the participants (Ann and Patricia) mentioned that they had private health insurance but were informed by the paramedic crews that the public system was the only option for their most recent admission. Overall, none of the study participants reported financial difficulties associated with their meeting health care needs.

8.3.5 Approachability

The theme of approachability relates to clients' being able to identify that a service exists and, that if reached, it will have a positive impact on their health. Incorporated in this theme is the ability of the client to perceive the need for care, which is determined by factors including health literacy, the client's knowledge about health and the client's own beliefs related to health and sickness.[228]

Knowledge of services

All of the participants in this study were aware that a service existed; however, there were differing views as to the best place to go for required care. For example, when Brian was feeling unwell he stated

> *I wanted to get to the hospital. Because that's the best place to go to in these things ……. They know what to do, they know all about it and everything*. [Brian]

When questioned on why he initially went to his GP but did not go back to see her when his condition deteriorated, he explained:

> *Well, it wasn't too bad the first time I went to the GP.* [Brian]

Ann also indicated that the hospital was the best place to go for her CCF management:

I know I'm safe when I go to the Royal [hospital] *with this complaint.* [Ann]

Perceived need for care

In general, the participants displayed the ability to perceive the need for care. Each of them was able to give a detailed account of the deterioration in their condition and could, in retrospect, pin point that the decline from normal health had commenced many days, or even weeks prior to their admission:

First of all, I had a very bad fall here. So I left that for a week or so without getting medical help. [Ann]

Okay, well I'll start back in December [3 months earlier]. [Patricia]

The lead up to it was - it'd probably be two or three weeks before, wouldn't it? [Michael]

I know now, I'd been having this breathing problem for two or three days. [Brian]

Knowledge about own health / health literacy

Similarly, all participants could list worsening symptoms that had alerted them to a change in condition and a detraction from their normal state of health:

Hard of breathing, breathlessness. [Ann]

And yeah, I just all of a sudden have to take it easy, I'm too out of breath with everything. [Patricia]

And it got to the point where I was having a little bit of trouble breathing. I'd have to sit up in that chair at night to breathe. [Michael]

I wasn't breathing properly. [Brian]

As regards health literacy, a number of the participants displayed some understanding of their condition. For example, Ann was able to accurately describe the effects of her heart fibrillation on her circulation:

I've got a heart fibrillation, and so the only thing I really know is that my heart is not strong enough to pump the fluid through, I guess that's how you'd say it. [Ann]

Similarly, two of the participants displayed a good understanding of the actions of the medications they were taking:

> *And they* [diuretic tablets] *got rid of a lot of fluid on my legs.* [Patricia]

> *They* [diuretic tablets] *help the lungs to get rid of the, or help the heart to get rid of the, what would you call it* [fluid]. [Brian]

However, three of the participants (Ann, Michael and Brian) appeared to have no knowledge that they had CCF.

Overall, as regards the theme of approachability, all participants were aware of the availability of services and that seeking help for their needs would improve their condition. Through past experience, they perceived that when they developed symptoms such as SOB or fluid retention, this was best addressed in the public hospital, rather than at their primary care provider. All participants had the ability to perceive the need for care, although all delayed care seeking until their condition had deteriorated to the point of requiring a hospital admission. Inadequate health literacy is likely to have played a part in this delayed care seeking behaviour. Interestingly, all bar one participant (Ann) was unaware that they had CCF.

8.3.6 Acceptability

The theme of acceptability relates to cultural and social factors and whether seeking care is judged as appropriate by society. Incorporated in this domain is the ability of the client to seek care, which is determined by factors including personal autonomy, knowledge about options in the system, and having the capacity to choose to seek health care.[228]

Knowledge of health care options

The participants displayed some knowledge of health care options, but these options were limited to seeing their GP or presenting to the ED. For example, when Brian was asked what he would do if he developed similar symptoms, he stated:

> *I'd ring the ambulance again, go right in there where the doctors know me.* [Brian]

When asked why he would go directly to the hospital rather than his GP his reply

> *Well, of course you just can't see a doctor in the middle of the night or middle of the morning.* [Brian]

indicated he was unaware of the availability of after-hours services. This reply also showed his knowledge regarding how his GP surgery operated; that is, he would be unlikely to get an appointment immediately. Brian also made it clear that, from his prospective, the GP was good for routine care but that the ED was the place to go if he had an urgent complaint.

Similarly, when asked the question what he would do if his symptoms returned, Michael answered

> *It's pretty straightforward at the present time, I ring an ambulance and go.* [Michael]

Both Ann and Patricia were aware of the option of going to the local private ED, but both were informed by the paramedic crews that the private hospitals would not be able to see them in their current condition:

> *And the ambulance ring the private hospitals, but obviously they won't take people with respiratory problems, or they say, no.* [Ann]

> *They* [paramedics] *said your cardiologist is at the Royal* [public hospital], *and there was no cardiologist at the private health - private hospital. So I went in there.* [Patricia]

Both accepted that this was just how the system works.

Societal views on care seeking

When considering whether seeking care is judged appropriate by society, Michael appeared to think he needed to 'tough-it-out' rather than bothering people. As explained by his wife:

> *But he thinks it's putting them out, if he rings them* [ambulance] *and he's alright.* [Michael's wife]

Michael's wife thought he should have gone to see his GP three weeks earlier and Michael admitted that he finally went

> *Because I was feeling lousy.* [Michael]

In retrospect, Michael did acknowledge that he had probably waited too long to seek care:

> *Well, it falls back on me when I should make decisions earlier.* [Michael]

Although, he also said that in a similar situation he would call the ambulance rather than go to his GP.

Patricia felt she was judged by the inpatient team as attending the ED inappropriately. She could see that the oral diuretics prescribed by her GP were slowly working, and was happy when her GP said he would admit her for an infusion of diuretics:

> *And I said, "Thank God, will that* [diuretic infusion] *get rid of the rest of the fluid?"* [Patricia]

However, when the inpatient team informed her that they didn't think she had fluid on the lungs and did not require the infusion, she was upset and felt they treated her badly:

> *I wasn't listened to in December. I wasn't listened to now.* [Patricia]

Overall, as regards the theme of acceptability, the participants exhibited good capacity to choose to seek care. Their knowledge of options for health care was limited to their GP or the ED. The option of calling an ambulance and/or presenting to the ED as required was one that had been reinforced for them during previous experiences. One participant (Michael) was wary of burdening the system and one (Patricia) felt judged by the hospital inpatient team as using the system inappropriately, even though she had been sent to the ED by her GP.

8.3.7 Availability & accommodation

The theme of availability and accommodation relates to the fact that a service actually exists, and can be physically accessed in a timely manner, including the availability of timely appointments relative to perceived need. It also relates to the characteristics of providers in terms of distribution of services and modes of service provision. Incorporated in this theme is the ability of the client to reach health care, which is determined by the client's physical mobility, the availability of transportation and their knowledge about the services available to them.[228]

Availability of services

All four participants lived quite close to the GP surgery and had no transportation issues, having the ability to either drive themselves or a family member available if required. As regards getting an appointment in a timely manner relative to perceived need, the participants spoke of 'being fitted in' but not necessarily with their regular GP:

> *Well, it may not be with my GP* [same day appointment] *because she may not be there. But there's always someone there that will see you.* [Ann]

> *Oh no* [get an appointment today], *because he might be very busy. But he would somehow try to fit it in.* [Patricia]
>
> *Yes if you say, look I really think I should see* [someone today]- *it might not necessarily be my regular GP but they'll fit you in somewhere.* [Michael]
>
> *Mostly, yes* [get a same day appointment]. *Sometimes hard, especially when I was seeing Doctor* [regular GP], *she was very hard to get into it* [sic]. *But I've had no trouble with getting to Doctor* [different GP, same surgery]. *I would possibly get an appointment* [today]. *Possibly not.* [Brian]

The participants were all accepting of this 'fitting in' process. As Ann said when asked if she was happy with seeing any GP at the practice:

> *Oh well yes, if it's for my health, I do.* [Ann]

When asked for a final comment about his perceptions of access to required care, Michael summed it up:

> *But the system itself, well I've never had any complaints about it….It's all good as far as I'm concerned, yeah. They look after you, they really do.* [Michael]

Similarly, Ann's final comment on the system and the availability of services:

> *And I think we're very, very lucky for what we've got.* [Ann]

shows that, from her point of view, people should be happy with the system they have, as well as an acceptance that, even though she may not get an appointment with her preferred GP, this is just how the system works.

Overall, as regards the theme of availability and accommodation, the participants stated that they had no issues with transportation required to physically reach care. All participants described how they were usually (but not always) 'fitted in' with any available GP at their practice, if they required a same-day appointment. They were very accepting that this was how the system worked and they had no complaints and felt lucky to have what they have.

8.3.8 Appropriateness

The theme of appropriateness relates to the 'fit' between available services relative to the client's needs. This includes time spent in assessing health problems and determining correct treatment. Interpersonal qualities of the provider and quality of care provided are included

here, as well as the integration and continuous nature of services. Incorporated in this theme is the ability of the client to engage in their health care and be involved in decisions about their treatment. This is determined by the client's motivation to participate and capacity to communicate, which in turn relates to health literacy and self-efficacy.[228]

Interpersonal quality of provider/s

All four participants felt that they had a good relationship with their GP and had been attending the same surgery for a significant period of time. For example, Brian's response to a question about his relationship with his GP was:

> *I don't have to say anything to the staff, I just go in and they say, "Yeah, go and sit over there," or wherever. They know my name.* [Brian]

Similarly, the participants reported how nice the staff at the hospital were:

> *A lot of the staff in the Royal* [hospital] *are beautiful. Couldn't look after you better.* [Patricia]
>
> *They* [ED staff] *took me into a cubicle, immediately went to service me, you know, ECGs and all that stuff. Yeah, they were quite* [good]. [Michael]
>
> *They* [staff at hospital] *are very caring and I found them exceptionally caring.* [Brian]

However, Patricia was concerned about what she described as poor interpersonal skills from some medical staff at the hospital:

> *I met some really nice doctors. But not the ones in the Royal* [hospital]. [Patricia]

Patricia also described the lack of interaction with the cardiologist when she was an inpatient:

> *There was one* [a cardiologist] *who came into the hospital, but he never took any notice how I was.* [Patricia]

Continuity of care and integration of services

Three of the participants (Ann, Michael and Brian) suggested that they were happy to accept an appointment with any GP at the practice, which could be taken as an indication that continuity of care with their regular GP was not important to them. However, it was clear from other comments that continuity did matter to the participants, including integration between the acute and primary care sectors. For example, Brian was clear that he was happy

to see any GP in the practice. However, at his most recent visit he did not see his usual GP. When questioned as to which GP he would like to see on his next visit he stated his preference to see the doctor who was up to date with his recent medical history:

> *Because she knows the history now, and* [regular GP] *doesn't know the history…. well at the present moment I'll see the one that knows the history.* [Brian]

Similarly, as regards integration between the hospital and primary care, two participants spoke about the hospital sending an account of their recent admission to their GP:

> *Of course, the hospital gave me a medication list I wanted her* [GP] *to see, …. the hospital will have contacted her* [GP]. [Brian]

> *They'll have all the reports - he'll* [GP] *have all the reports from the hospital.* [Michael]

Both participants indicated that they viewed this sharing of information as a good thing. Conversely, Patricia's experience of attending the ED with a letter from her GP, which she felt was ignored, left her feeling very upset. She felt the ward nurse confirmed the lack of integration between the primary and acute sectors:

> *The nurse* [ward nurse] *and he said, oh they don't take any notice of my doctor* [Patricia's GP]. [Patricia]

Which left her wondering

> *why send people to hospital?* [Patricia]

Participation and involvement of client in decisions about care

Although the participants did not comment directly on being involved in decisions about their care, several of the experiences they described, particularly whilst in hospital, could be interpreted as having care 'done to them' rather than involving them. For example, Patricia described a situation where, although she had a colonoscopy booked privately, whilst an inpatient she was fasted for five days in a row for a colonoscopy, without any consultation with her:

> *I never said to them, because I've got private health, and I was getting done* [colonoscopy] *with Dr* [private doctor]. *But they decided in the Royal* [hospital] *that I was to have it done. [Patricia]*

Similarly, when Michael was unwell the night before his planned discharge and his daughter felt he should not be sent home, his wife's thinking was:

> *All right, well there's nothing we can do. If they say he's going home, he goes home.* [Michael's wife]

An indication of the lack of participant involvement in care decisions can be seen in Brian's response when asked the reason for his recent admission, and whether he thought it was because of a cardiac or a respiratory condition:

> *I did have* [the] *doctor order me two x-rays down there of the chest, so I don't know.* [Brian]

He did acknowledge that a ward nurse came and spoke to him before discharge, but he didn't really understand what she was saying to him:

> *The* [ward] *nurse came and spoke to me but I'm not too sure what it was all about now, no.* [Brian]

Similarly, Patricia described a lack of involvement in her discharge planning. She described the process as:

> *The next morning when the doctor's come round, he checked me over, and he said, "No," he said, "You can go home."* [Patricia]

The participants seemed very accepting that this was just how things are done in the hospital environment.

More positively, the participants gave some examples where they were included in decisions about their care, but always outside of the acute care environment. Patricia talked about discussions she had had with her GP and her cardiologist, in relation to how best to manage her diuretic therapy for oedema:

> *You've got too much fluid on you still,* [patients name]*. Oh, I'm going to put you on these tablets [diuretics].* [discussion between Patricia and her cardiologist]

Similarly, Brian relayed a discussion he had had with his GP related to his diuretic therapy:

> *When the doctor seen me on that particular Thursday morning I said to the doctor, I said, "What dosage of that tablet?" She said, "One a day." Yeah. But because they're not as strong as they were, they told me to take two tablets, because these are different strength.* [Brian]

The participants who gave examples of discussing their treatments with clinicians appeared happy to be involved and able to act on information provided.

Ability to self-management

When asked, each participant said that they had not been given any advice on discharge from the hospital on how to manage their condition if they were to develop similar symptoms. Similarly, all participants stated they had not been given education by their GP on how to manage their CCF. It is worth remembering that three of the four participants did not seem to be aware that they had CCF, nor that their most recent admission had been for CCF. When asked if she had a plan with her GP covering symptoms to look out for indicating she should make an appointment, Ann indicated that no such plan was in place:

> *No, I think maybe at my age you get an idea when you should go, when the time is nearly up.* [Ann]

The only advice Michael could remember receiving was when he attended his GP, having been SOB for three weeks:

> *He said* [GP]*, "You should've rung an ambulance last night. If this happens again, just ring an ambulance straight away."* [Michael]

When asked if looking back they could see if anything could have prevented their recent admission, all participants said no. Michael stated:

> *Oh well, you never really think you're going to go to hospital. But that's where you end up.* [Michael]

One participant, Brian, who had not been able to see his regular GP at his most recent appointment, was really pleased to have been given a written discharge plan:

> *This thing here [written discharge plan] is very handy. Doctor [regular GP] never ever done this for me, give me a letter to do all these things, and I found that very helpful with diet and that.* [Brian]

Similarly, Michael was glad to have been given a written copy of his medications, including changes made during his recent admission, on discharge. He referred to this during the interview and was keen to share it with his GP.

As regards the theme of appropriateness, all participants were satisfied with the interpersonal skills of the clinicians they came into contact with, both in the acute and primary care areas, with the exception of Patricia's reported negative experiences during both of her recent hospital admissions. Although considering that an appointment with any GP at the practice was acceptable, continuity of care was clearly important to the participants. Sharing of health information between the primary and acute care sectors was also seen as valuable. Participants seemed to have some involvement in decisions about their care in the primary sector, but this did not translate into the hospital environment. As inpatients, the participants seemed to become bystanders in the proceedings, and had care 'done to them', without consultation or discussion. However, all except Patricia accepted that this was good care. All of the participants reported that they were not provided with information or advice about their recent admission, their CCF nor how to manage similar symptoms in the future. Two participants (Brian and Michael) who were provided with written information, judged this to be a good thing and referred to this information during their interviews.

8.4 Discussion

Although at the point of presentation to the ED all of the participants required a short-stay hospital admission for their CCF, reinforcing their decision to attend the ED as the correct course of action, the main point that emerged from each interview was that, if the participants had had earlier access to primary care, each of their recent admissions could potentially have been delayed, if not avoided completely. The results of the analysis confirm that, although the participants perceived that they had good access to care when they required it, when viewed through the lens of the domains of access to care, their actual access was less than ideal. The main areas of concern identified related to a lack of person-centred care, particularly in the acute care setting, as well as an apparent total absence of patient education, leading to an inability of participants to self-manage care and be involved in decisions about care. Lack of continuity of care in the primary care setting was also identified as problematic. In effect, the analysis suggested that if the participants had been given the tools to recognise their deteriorating condition, and a plan of action when such deteriorations occurred, they may not have required an ED presentation or hospital admission. However, all of the participants appeared to accept that the care they were receiving was of good quality, and perceived they had good access to the services they required.

8.4.1 Person-centred care

The themes of patient-centeredness and self-management are evident in many reports referring to best practice in the prevention and management of chronic conditions. In the 2013 WHO report, *Global action plan for the prevention and control of* [vii]*non-communicable diseases*, one of six objectives listed is the need to strengthen health systems through *people-centred primary health care.*[285(p.5)] Similarly, in the 2017 *National strategic framework for chronic conditions,* COAG acknowledged the importance of using person-centred approaches in combating the increasing burden that chronic diseases exert on the Australian healthcare system.[286] The participants in the current study gave many examples of a lack of patient-centeredness in approaches to their care management, particularly in the acute setting. The experiences they described depict a system where, the patient is often treated as a 'condition', in this case CCF, where tests are undertaken without explanation to or consultation with the patient, to 'fix' the presenting symptoms. The patient is discharged, without regard to their understanding of what led to the hospital admission, or strategies put in place to help mitigate against a future short-stay PPH. Michael's wife indicated that they did not feel they had the right to say they did not feel he was ready for discharge, even though his condition had deteriorated in the night. Similarly, Patricia gave an example of how she was told she could go home without discussion or any input from her.

Acknowledging the increasing numbers of hospital admissions and readmissions for CCF, and that in many instances these hospitalisations were preventable, in 2013 The National Heart Foundation of Australia put forward some principles and recommendations for better management of CCF, which they suggested could reduce the likelihood of ED presentations and hospitalisations.[292] At the core of the statement was the belief that accessible, multi-disciplinary, guideline-based, patient-centred CCF care improves patient outcomes.[292] They included a definition of patient-centred care, from the Ontario Medical Association:

> A patient-centred care system is one where patients can move freely along a care pathway without regard to which physician, other health-care provider, institution or community resource they need at that moment in time. The system is one that

[vii] Non-communicable disease is a term used to describe chronic health conditions

> considers the individual needs of patients and treats them with respect and dignity.[335(p.34)]

This definition is included here as it speaks to the heart of access to care from the patient's perspective, as detailed in Lévesque's conceptual framework of access to healthcare.[228] If patients are to be able to *'move freely along a care pathway'*, they would need to be health literate enough to understand their care requirements, and where and when to access required care (approachability), as well as have appropriate services available to them and the ability to be involved in decisions about their care (appropriateness). Similarly, if patients are to access care '*without regard to which physician, other health-care provider, institution or community resource they need at that moment in time'*, the cultural and social needs of potential healthcare users must be taken into consideration (acceptability), as well as whether the patient has the ability to pay (affordability), and physically reach required health care in a timely manner (availability and accommodation).

8.4.2 Continuity of care

Central to person-centred care in the community is the provision of continuity of care with a regular primary care provider. The participants in the current study described a system where they are 'fitted in' with any available GP, and not necessarily in a timely manner. The data analysis showed that the participants recognised the importance of care continuity. This was particularly evident when Brian acknowledged that, even though he had a great relationship with his regular GP, he would now prefer to see the new GP who was aware of his most recent history. The participants also showed an awareness that the integration of care across the primary and acute care sectors was beneficial to their health care.

There is a growing body of evidence that suggests that good continuity of primary care has the ability to reduce PPHs.[260, 261, 336, 337] A recent cross-sectional study from the UK, which examined the relationship between PPH rates and population, GP and hospital characteristics, reported a 9% increase in PPHs for patients who experienced poor continuity of GP care. The association was greatest for patients experiencing PPHs for chronic conditions.[338] Similarly, another UK study that focussed specifically on PPHs in the elderly (aged 62-82 years) reported that increasing access to a usual provider could reduce PPHs by 6.2%.[260] There is also increasing evidence in the academic literature that good continuity of primary care has the ability to reduce ED presentations,[339] including ED utilisation by the elderly.[213, 214]

Australian researchers have called for further research into care coordination specifically targeted at the elderly with multi-morbidity,[340] as well as primary care based CCF disease management programs.[341] As discussed in Chapter 6 of this thesis, the Australian government is currently trialling a new model of primary health care, the patient-centred healthcare home (HCH), specifically aimed at providing better coordinated and flexible care for people with complex and chronic conditions.[279] Among the promised benefits to patients who choose to enrol in the HCH is that they will have a committed care team, that will be led by their usual GP, in essence, promising better care continuity for those enrolled. An early evaluation of 15 Primary Care Homes in the UK showed promising results, with one site reporting a reduction in hospital admissions for frail elderly patients.[342] Conversely, a study in America that undertook a meta-analysis of 11 evaluations of patient-centred medical homes reported no overall effect on the majority of measures analysed (e.g. use of primary, inpatient and ED care, impact on PPHs).[343] Both of these studies acknowledged high levels of heterogenicity in the ways the models were set up, leading to difficulties in the analyses.[342, 343] A report from the Deeble Institute in Australia that looked at models of healthcare homes introduced in other countries, recommended that, among other things, the model in Australia be patient-centred, coordinated and provide continuous and collaborative relationships.[344] At the time of writing, there were more than 170 HCHs in operation across Australia, with evaluation due to commence in 2019.[279] As one of the goals of HCHs is to provide *'patient-centred, coordinated, flexible care,'*[279] It is encouraging to note that patients enrolled in the program are encouraged to be involved in the evaluation, making it more likely that patients' views will be taken into consideration in the designing of this new model of care.

Participants in phase four of the current study were not asked if their GP was involved in the HCH trial. It is also impossible to say whether, if asked, the participants would wish to be involved in the trial. However, it was evident that all of the participants valued having an ongoing relationship with a primary care provider who was knowledgeable about their condition and with whom they had developed a connection.

8.4.3 Self-management

Integral to person-centred care for individuals with chronic conditions is the ability to self-manage and to work in partnership with their health care team to improve overall quality of life. The WHO,[285] COAG,[286] and the National Heart Foundation of Australia[292] all stress the

importance of patients with chronic conditions being partners in their care. Therefore, it is of real concern that three out of four of the participants in the current study were unaware that they had CCF, making it impossible to be involved in decisions about the management of their condition. Even Ann, who had first had heart surgery over 50 years ago and was therefore well aware of her condition, had seemingly not been provided with any education on how to manage what could be seen as predictable symptoms, such as increasing SOB or oedema, indicating a potential deterioration in condition.

These findings are similar to those from a recent interview study undertaken in Victoria, Australia where a lack of awareness of their condition was seen as a potential contributing factor for 22 of 24 participants who had had a recent PPH for a chronic condition.[345] Longman and colleagues reported patients' lack of knowledge about how and when to seek treatment, as well as participants only recognising the signs and symptoms of deterioration in retrospect, as negative consequences of their lack of awareness of their condition.[345] An Australian root cause analysis of why community dwelling, older adults with multi-morbidity experienced unplanned hospital admissions reported similar findings, with patients acknowledging that they did not know whom to call when their condition deeriorated.[277] Reed and colleagues recommended that more attention be paid to care planning for the predictable consequences of chronic disease, including ensuring patients are aware of whom to contact if increasing symptomology should occur.[277] In essence, Reed advocated for teaching patients how to self-manage their chronic condition when predictable 'red flag' symptoms are evident, and suggested that this may assist in reducing hospital admissions for this cohort of patients.[277]

There is research evidence to support the assertion that patients who are enabled to self-manage their condition have lower rates of acute care utilisation. A recent UK study that investigated the association between patient self-management capability and healthcare utilisation reported significantly lower rates of ED presentations and acute admissions in groups identified as having the highest levels of self-management capability.[346] The significant reduction in emergency admissions was also seen in patients aged over 75 years.[346] One group in South Australia undertook a retrospective cohort study to assess the association between provision of a GP management plan (GPMP) and time to next PPH for older patients (aged ≥ 65 years) with HF.[347] The group reported a 23% reduction in the rate of PPHs for HF for patients with a GPMP compare to those without.[347] Similarly, although not specifically addressing self-management for older patients with chronic conditions, a systematic review

of RCTs investigating the efficacy of interventions to reduce hospital readmissions found that supporting patient capacity for self-care was 1.3 times more effective than other interventions at reducing readmissions.[348]

It is evident that that many patients with chronic conditions wish to be empowered to self-manage their care. An Australian group undertook focus group research with 76 consumers who had chronic conditions. All ten focus groups discussed self-management, with some participants expressing the view that they were the 'experts' in the management of their condition.[349] Others felt that their GP actively discouraged them from taking an active role in managing their condition, although there was disagreement among the groups on this point.[349] A 2016 report to gauge global perceptions about the accessibility and integration of health systems, found that although 69% of patients from 13 countries (Australia, Brazil, China, France, Germany, Japan, the Netherlands, Singapore, South Africa, Sweden, the United Arab Emirates, the UK and the United States) felt they had the knowledge to effectively manage their health care, only 40% of healthcare professionals agreed.[350] The Australian figures were 73 and 47%, respectively.[350] Suggested reasons for these discrepancies included clinician fears of loss of authority and fear of litigation.[350] A comprehensive UK report into support for patient self-management acknowledged that the attitudes and skills of clinicians can be a major barrier.[351] de Silva called for more education for clinicians about the value of supporting self-management, as well as the skills required by clinicians to achieve this.[351]

As regards the participants in the current study, each presented as articulate and knowledgeable about the medications they were currently taking. Each was able to give a detailed account of his/her recent admissions. Two of the participants (Michael and Brian) had diabetes and appeared to be capably involved in the management of the condition, with Brian explaining how he checked his blood sugar levels throughout the day. In the opinion of the researcher, with proper education and support, each of the study participants could have increased involvement in the management of their CCF, in partnership with their GP. As advocated by Reed and colleagues,[277] provision of written care plans by their GP, detailing common symptoms of CCF, with a plan for whom to contact and when, in the event of worsening of these symptoms, could potentially avoid future short-stay PPHs for their CCF.

8.4.4 Health literacy

The importance of improving the health literacy of populations in an effort to enable better self-management of health is acknowledged both nationally,[22, 286] and internationally.[285] Health literacy has been defined as:

> people's knowledge, motivation and competencies to access, understand, appraise, and apply health information in order to make judgements and take decisions in everyday life concerning healthcare, disease prevention and health promotion to maintain or improve quality of life.[352(p. 3)]

Low levels of health literacy have been linked to increased PPHs. In one American cross-sectional observational study, patients with inadequate levels of health literacy were found to have 2.3 times the number of potentially preventable ED visits resulting in a hospital admission, when compared to those with adequate levels.[276] Similarly, Reed's root cause analysis discussed previously found that low levels of health literacy was one of the factors identified as increasing PPHs for the elderly.[277] One Australian group reported on a pilot program that implemented anticipatory care plans in general practice as an approach to improving the health literacy of patients at risk of utilising health care services in the after-hours period.[353] Evangelista and colleagues reported positive outcomes, with 63% of practices reporting a reduced need for their patients to seek medical assistance in the after-hours period following the introduction of the plan.[353] As discussed above, patients who are supported to self-manage their chronic condition have better outcomes in terms of reduced hospitalisations. Therefore, it is important to note that inadequate health literacy has been reported to be a major barrier when providing education to patients with chronic conditions.[354]

It has been identified that, in Tasmania, over 60% of the population has inadequate levels of health literacy, which is slightly higher than the national average.[275] Levels of health literacy of the participants in the current study were not measured, but as levels are known to generally decline with increasing age,[275] it is likely that the percentage of Tasmanians aged ≥ 75 years with inadequate levels of health literacy is even greater. The Tasmanian government has developed a plan of action to improve health literacy across the state.[278] One of the aims of the plan is to improve levels of health literacy within the population to help Tasmanians manage their own health.[278] The plan includes strategies such as working with the state's

health workforce to increase awareness of the challenges of poor health literacy, as well as ensuring that health information is more effectively communicated.[278] On a national level, an Australia discussion paper on new models of primary care to meet the challenges of chronic disease prevention and management listed self-management support and improving health literacy as the first in a series of key recommended elements of any new model of care.[355]

The participants in stage four of the current study appeared to be knowledgeable about the medications they were prescribed and were happy to share information about their condition, as far as they understood it. All of the participants presented as individuals who would respond well to receiving education about their CCF and how best to manage their condition, with the aim of reducing future hospitalisations. As stated by Brian, a written GP management plan, that can be referred to when at home *'is very handy. I found that very helpful'*.

8.4.5 Limitations

Phase four of this study has several limitations. Firstly, this was a purposive sample of a small number of participants from one Australian region. Their views and experiences may not be representative of other populations and therefore limit transferability of specific findings. However, as each of the participants described similar experiences with continuity of care, coupled with a poor understanding of how best to manage their CCF, it is likely that other elderly residents of the region who experience short-stay PPHs for chronic conditions face similar issues. Secondly, all of the participants in the current study presented as articulate and keen to be involved in self-management of their chronic condition. It is unlikely that all elderly residents in the region would be as capable or willing to take on this role.

Thirdly, recruitment of interview participants proved more difficult than anticipated. The sequential study design, leading to delays in deciding who should be interviewed, coupled with the time-consuming process of awaiting ethics approval to undertake the study meant that recruitment was limited to eight months. Difficulties involving clinicians in recruiting an incident as opposed to a prevalent population have been described in the literature.[356] White and Hind reported that recruitment was heavily dependent on the workload and previous research experience of the clinician, as well as clinician engagement with the research team.[356] Whilst every effort was made to engage the recruitment nurses in the research, and to understand their difficulties in identifying potential participants, due to project timelines,

recruitment ceased after the fourth interview. Nevertheless, the similar experiences described by all of the included participants suggests that recruitment of more participants may not have yielded any further insights regarding patient-perceived access.

Finally, the deductive approach to data analysis, whereby data are coded using pre-determined themes, has the potential for 'forcing the fit' of the data under each theme. However, at the initial coding stage an 'other' theme was included to allow for the development of themes outside of the domains of access. Ultimately, all the data was coded under one of the predetermined themes.

8.5 Conclusion

Participants in the current study described coping with a build-up of worsening symptoms, some over a significant period of time, before eventually attending the ED and experiencing a short-stay hospital admission for their chronic condition. Each participants' story depicted a system where patients are discharged home with no specific follow-up, little or no education about the management of their chronic condition or understanding of what circumstances led to that admission. Results of this study identified a link between patient-perceived access to care and each participant's experience. The experiences described by the participants suggest that specific health literacy interventions, enhanced continuity of GP care, genuine person-centred care and targeted patient education could have the potential to delay or prevent future ED attendances for this cohort of patients.

It is clear that all areas of healthcare systems, including EDs, are struggling to cope with the increasing demands placed on them by the elderly with complex and chronic conditions. Governments nationally and internationally are investigating ways to improve services outside of the acute care sector to mitigate against increasingly unsustainable demands on emergency services. Findings from phase four of this research suggest that focusing on patient-perceived access to care, with a particular emphasis on improving the health literacy of the population to support patient self-management, as well as enhancing the availability of timely appointments with a regular primary care provider and thereby providing person-centred care may go some way towards achieving this aim.

Chapter 9. Discussion

"You know what the issue is with this world?
Everyone wants a magical solution to their problem,
and everyone refuses to believe in magic."
— Lewis Carroll, Alice in Wonderland

9.1 Introduction

It is evident that the issue of hospital ED crowding, with its negative consequences for patients, staff and the system itself, is one of the biggest problems facing healthcare delivery worldwide. It is also clear that nationally and internationally, systems are struggling to cope with the ever-increasing demand for emergency services. What is driving this sustained increase, and what can be done to ameliorate the problem? Within Australia, the island state of Tasmania has been identified as performing poorly in terms of national indicators for ED performance. The state has also been identified as having all the 'key factors' that could make it more likely that a person will attend the ED. It was hoped that by understanding the factors driving ED utilisation in this region, recommendations could be made to policy makers and researchers on initiatives to reduce ED utilisation, not only locally, but nationally and internationally. Therefore, this thesis used a multiphase, emergent mixed methods, sequential explanatory approach to examine temporal and regional patterns in hospital ED presentations in Tasmania, and subsequently investigate the factors driving ED utilisation.

9.2 Study findings

This study had several key findings:

- The systematic review highlighted a dearth in the international literature of studies investigating the specific causes of ED crowding. The causes of crowding are not well understood and likely to be contextually specific to the environment in which the crowding is taking place. The review also illustrated that there are an abundance of studies identifying negative consequences of ED crowding for patients, staff and the healthcare system, thereby reinforcing the need to shift the research focus away from identifying consequences

and more towards isolating local causes. ED presentations by elderly patients with chronic and complex medical conditions emerged as a relatively new driver of crowding.

- Phase one (ED data analysis) identified wide-ranging regional variations in patterns of ED usage across the state of Tasmania, with the greatest recent increases being in the South. The data analysis identified a significant increase in ED presentations by those aged ≥ 75 years over a four-year period in the South, a finding not replicated in the state's other two major regions.
- Phase two (inpatient data analysis) identified a likely link between patient-perceived access to care and increased ED utilisation and subsequent short-stay hospitalisations by patients aged ≥ 75 years in the South of the state. Patients with chronic conditions accounted for the greatest proportion of these admissions. CCF was identified as the most common associated condition for short-stay admissions, which had increased by 174% over six years.
- Phase three (DMR audit) identified that there had been no appreciable change in the demographic or disease profiles of older patients experiencing short-stay admissions for CCF over a six-year period in the South of the state. The audit also identified no apparent change in the ways elderly patients with CCF utilised the system, leaving unexplained the large increase in the numbers of presentations from the first to the last year of the audit. An acute-system response of reducing LOS even further (from 2 days to 1 day) was the main change detected.
- Phase four (patient interviews) appeared to confirm the link between patient-perceived access to care, ED presentations and short-stay admissions for elderly patients with a chronic condition in one Australian region. Identified local issues related to a lack of person-centred care, particularly in the acute care setting, as well as an apparent lack of patient education enabling elderly patients to self-manage their chronic conditions. Poor continuity of care in the primary care setting and inadequate levels of health literacy were also identified as problematic.
- The research design used in this thesis provided new insights into the factors contributing to ED utilisation by elderly residents in the South of the state. The sequential explanatory approach allowed for new questions to emerge following each new phase, with the prospect of addressing these questions in subsequent phases. The detailed quantitative analysis identified who (i.e. elderly patients with chronic conditions) to engage to get a better

understanding of factors influencing ED utilisation, whereas the qualitative phase provided the opportunity to understand, from the patient's perspective, the issues driving ED presentations by this patient cohort. Neither the quantitative nor the qualitative phases alone could have provided the same depth of understanding of the issue.

This chapter will discuss the study findings in the context of the broader literature in the field of elderly people with complex and chronic conditions and their impact on ED demand. Examples of successes in reducing hospital activity for patients with chronic conditions will be discussed. Limitations of the research will also be considered. Finally, some recommendations for further research, as well as suggestions for policy makers, will be given.

9.3 Increased ED demand

Perhaps the most surprising finding of this study was the dearth in the published international literature as to the causes of ED crowding. Only fourteen studies that addressed the causes of crowding met the criteria for inclusion in the systematic review (Chapter 3), with 50% of these assessed as providing low quality evidance.[284] This is particularly concerning considering the vast number of studies published detailing the effects of trialled or modelled solutions. Anecdotally, the causes of increased ED demand are widely known: people attend the ED because it is free, a one-stop-shop, convenient, they cannot get an appointment with their GP, they do not have a GP, they don't understand how the system works. Consequently, solutions aimed at reducing ED attendance often focus on addressing these issues. However, unless the specific, local drivers of ED utilisation are known, there is the potential for implemented solutions to be misaligned with specific causes.

This research identified an increase in ED demand in the South of the state, driven in part by elderly patients with chronic conditions.[89, 302] This finding has been replicated in other jurisdictions, both nationally[177] and Internationally.[101, 110, 112] The rise in the ageing population is often 'blamed' for this phenomenon. It is assumed that because the population is getting older, these elderly people will be sicker, with more comorbidities, require more ambulance transfers to hospital, and will inevitably require more hospitalisations. This situation seems to be accepted as a *fait acompli*, and that there is nothing that can be done except increase the number of acute inpatient beds to deal with the expected influx. Findings from this study, coupled with published research, indicate that this need not be the case.

In phase four of this study (Chapter 8) four such elderly patients, who had recently experienced a short-stay admission for their chronic illness, were interviewed. Analysis identified that all four of these admissions could potentially have been prevented if the participants had had better access to appropriate care in the community setting. As discussed in Chapter 8, each of the participants' stories illustrated a system where patients are often discharged home with no specific follow-up, and little or no education about the management of their chronic condition or understanding of what circumstances led to that admission. The similarities between each participant's experience makes it reasonable to assume that other elderly residents of the region experience similar issues when suffering an exacerbation of their chronic condition. The experiences described by the participants suggest that specific health literacy interventions, enhanced continuity of GP care, genuine person-centred care and targeted patient education could have the potential to delay or prevent future ED attendances for this cohort of patients. The academic literature describes many initiatives that have been successful in reducing ED presentations and hospital admissions for people with chronic conditions.

9.4 Reducing hospital activity for patients with chronic conditions

There are many published studies detailing successes in reducing ED presentations and subsequent hospital admissions for patients with CCF. Reported successful initiatives include the provision of specialists clinics,[357] telephone support for rural patients,[358] GP Management Plans (GPMPs),[347] Hospital at Home models of care,[359] home-based telephone management,[360] and self-management programs.[361, 362] Similarly, studies have shown success in reducing hospital activity for patients with other chronic conditions, for example by providing action plans for patients with COPD[363] or providing higher quality primary care to patients with diabetes.[262] Likewise, as discussed previously in this thesis (Chapter 5), an Australian group at HealthOne Mt Druitt were successful in reducing ED presentations and inpatient LOS for older patients with complex and chronic conditions by coordinating and integrating healthcare services.[364]

A recent review of systematic reviews investigating the effectiveness of integrated care in reducing hospital activities for patients with chronic conditions concluded that the greatest successes are achieved when initiatives are aimed at one particular condition.[365] Damery and colleagues speculated that this finding may be a reflection of the broader healthcare system,

wherein care for patients with complex needs is largely centred on single condition guidelines.[365] Many have suggested that it is time to move away from this episodic, siloed and reactive model of care, where acute care hospitals are the only entry point, and restructure the system to put the patient and primary care at its centre.[366, 367]

The problem of care provision being 'episodic' is not just an issue for the acute care system. In an Australian qualitative study exploring GPs' views on chronic care, participants described the lack of fit between the system, seen as orientated towards acute care, and the structured long-term care required for good chronic disease management.[368] Similarly, two Australian professors of general practice described the funding for primary care as favouring episodic care, which they considered ill-suited to the type of care required for chronic care management.[367] Harris and Zwar called for a change to the incentives and funding for chronic disease management.[367] It appears clear from the literature that clinicians and academics, both nationally and internationally, are calling for a redesign of current models of healthcare, to enable better planning and management for the *next frontier of healthcare,*[366(p. 89)] namely, people living with complex and multiple chronic health conditions.[267, 366, 369, 370]

9.5 Redesigning the system

9.5.1 The Canterbury model

There is good evidence in other jurisdictions of successes at both reducing healthcare costs, and lessening ED crowding by undertaking systemwide redesign. Possibly the most successful of these is evident in NZ. The District Health Board for Canterbury developed a system of integrated care whereby the demand for hospital and residential aged care services decreased over a seven-year period (2006-2013).[371] At the same time, the proportion of the population aged ≥ 65 years increased from 13.4 to 15%.[371] The transformation began in 2006, when it was identified that, if increased demand for acute care services continued unabated, by 2020 the Canterbury region would require another 500-bed hospital, 20% more GPs, and another 2,000 residential aged care places.[372, 373] This was simply unaffordable. A series of initiatives was instigated, including the creation of HealthPathways,[374] an Acute Demand Management System, and a Community Rehabilitation Enablement and Support Team, as well as strategies to address patient falls and medication management.[372] At the same time, there were changes within Canterbury hospitals, driven by a 'vision' of where the health system needed to go.[372]

An identified key feature leading to success was the strength of Canterbury's primary care sector. Prior to the changes, primary care in the region was already well organised, with 85% of its GPs belonging to an Independent Practitioner Association (IPA).[372] The largest IPA (Pegasus) had introduced best evidence-based education programs 'by GPs for GPs', that included education on which tests to order and when, thereby reducing clinical variation. GPs had also taken direct responsibility for all out-of-hours care, with a centralised nurse triage system.[372] As early as 2000, Pegasus was running a small program aimed at limiting acute hospital demand by diverting into general practice or community settings patients who would otherwise have been admitted to hospital.[372] Pegasus also runs a 24-hour surgery, staffed by local GPs, with a 5-bed observation unit. The surgery provides access to radiology and pathology services. Unlike the free services available at the ED, the surgery charges the user an unsubsidised $75, but sees approximately 75,000 patients per year, compared with the 80,000 seen at the ED (2013).[372]

The transformation in Canterbury involved a whole-of-system approach whereby clinicians from all sectors were involved in designing the change. Over 2,000 employees of the system (18,000 employees total) attended a 'showcase' over a six-week period, where they were given the opportunity to look at various challenges facing the health system, and asked to give their opinions on how they, personally, would transform the system.[372] A graphic artist captured the ideas and a pictogram was used to illustrate how the health system should develop (Fig. 9.1).[372] Perhaps the biggest 'change' depicted in the illustration was that the patient was at the centre of the service, with the hospital sector on the outside ring, demonstrating the view that the focus should be on caring for patients in the community, using the hospital system as a last resort. The high level of engagement of health care workers across all sectors is seen as one of the key drivers of Canterbury's success. In a case study about the model for The Kings Fund, Timmins and Ham suggested that *the biggest change Canterbury has made…… is to re-invest in the professional pride of clinicians and other staff – taking significant steps to re-empower them to make change themselves…*[372(p. 42)]

Figure 9.1 Pictogram of the healthcare system in Canterbury[372]

Although funding for different sectors of the system in NZ were disjointed, the mantra for the change became 'one system, one budget', with a firmly held belief that each dollar could be spent only once.[372] Funding arrangements moved away from a fee-for-service model to more capacity-based contracts, where there were built-in incentives to manage costs.[372] At the same time, hospitals were encouraged to generate efficiencies but were assured that they would not be penalised by having money taken away from them.[372] The changes have been described as creating a *high trust, low bureaucracy* approach to funding.[372(p. 19)] The vision for the Canterbury model was centred around everyone working together to ensure the right care be delivered in the right place at the right time by the right person, and that a key measure of success was to reduce the amount of time patients spent waiting for care.[371, 372]

Although the model remains a work-in-progress, a measure of financial success is indicated by a move from a system that had a budget deficit of $17 million in 2007-08, to a budget surplus of $8 million in 2010-11.[372] In terms of its relevance to the current research project, although Christchurch hospital was regularly reported in the past as experiencing 'gridlock' leading to crowding in its ED, by 2012 this was a very rare occurence.[372] The reduction in ED demand was most notable among elderly presentations (> 60 years), whilst data also showed a reduction in the number of GP referrals of the elderly to the ED requiring an admission.[372]

Although not specifically related to the introduction of the model described above, Canterbury also successfully achieved a reduction in bed-occupancy for patients with COPD of 48% by redesigning the systems approach to acute exacerbations.[375] In essence, the Canterbury model put the patients at the centre of the healthcare system and integrated services to ensure they were organised to best suit the needs of the population the system was set up to serve. There are many lessons to be learnt from Canterbury for other healthcare systems trying to provide a high standard of care to an increasingly elderly population, while simultaneously working within budget constraints.

The Canterbury context has many similarities to Tasmania. The two regions have similar populations (500,000 approx.),[46, 372] with a larger proportion of their residents aged over 75 years, compared to their national averages.[46, 372] Similar to Canterbury prior to its redesign, the THS is struggling to keep pace with the increasing demand for acute healthcare services, driven in part by its elderly population and increased prevalence of chronic illness. Results from this thesis suggest that policy makers and clinicians in Tasmania should examine more closely the Canterbury experience, to ascertain whether lessons learned in their redesign of healthcare could be successfully implemented in the Tasmanian context. By endeavouring to put the patient at the centre of the system, Canterbury was successful at reducing ED crowding, as well as reducing ED presentations by the elderly. Perhaps this is an indication that more work should be undertaken locally to ensure that the priority is on providing genuine person-centred care, rather than a focus on ED-avoidance strategies, that is, putting the focus on the patient, rather than on the service.

9.5.2 The Bridgepoint model

Another area that has proven success at redesigning its systems to provide coordinated and integrated care for patients living with complex and chronic conditions is Bridgepoint, a hospital in Toronto, Canada. Due to the increases in patients living with chronic conditions (approximately 70% of Canada's population has one chronic condition), in the late 1990s, Bridgepoint found that it had come to specialise in providing care for patients with chronic and complex illnesses.[366] At the same time, policy makers decided that hospitals such as Bridgepoint were no longer required, and should close. Ultimately, hospital administrators and clinicians were successful in making policymakers see that the growing prevalence and

incidence of complex health conditions was a '*game changer'* for health systems, the hospital remained open, and plans began to *'change the world for complex patients'*.[366(p. 89)]

The group initially undertook a study to identify the characteristics, needs and experiences of the patient population within their healthcare system.[376] The study identified gaps in the system that ultimately led to the reorganising of care delivery to better suit the needs of the population.[366] The team at Bridgepoint developed a new model of care delivery that put the patient and the primary care system at the centre, and replaced old models of acute, episodic, reactive care (Fig. 9.2).[366] Similar to the Canterbury model, the Bridgepoint model undertook a whole-of-system approach to ensure seamless transitions for patients across the system from primary, to acute, to community care. Walsh, the CEO of Bridgepoint Active Healthcare, advocated for hospitals and the people in them to become full partners, not just with patients and families in their care, but also with primary and community care, and public health in managing the burden of chronic illness.[366] She also stressed the importance of ensuring the funding model is correct, so that there is a real incentive to truly provide care in the right place and at the right time.[366]

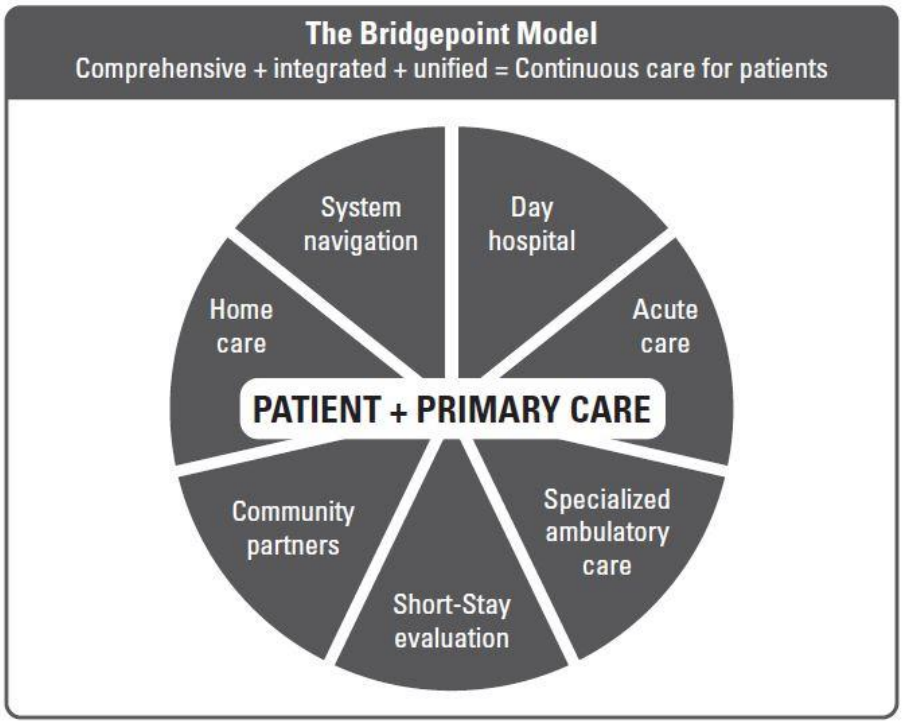

Figure 9.2 The Bridgepoint Model[366]

Whilst the large metropolitan centre of Bridgepoint is a very different context from the predominately rural state of Tasmania, there are lessons to be learned from Bridgepoint's transformation that could be translated into the THS. The initial study undertaken in Bridgepoint, whereby they interviewed 116 users of the system, enabled them to identify where the gaps in the system lay, and how best to address these from the patient's perspective.[376] This thesis has begun the process of understanding how the system works for elderly patients in Tasmania. Perhaps the success of the Bridgepoint model provides the justification to continue this line of enquiry, to provide insights into how the elderly with chronic conditions currently navigate the healthcare system in Tasmania. This in turn could provide insights into how best to transform the system to ensure better outcomes for elderly patients with chronic conditions. As stated by Professor Tom Marwick, a Tasmanian local and internationally-renowned cardiologist and researcher *the chronic disease epidemic (including HF) will require new approaches if we are to avoid it engulfing our health system.*[377]

9.5.3 The Scottish experience

In contrast to Canterbury and Bridgepoint, the Scottish experience was more of a 'top-down' approach to healthcare transformation. Faced with similar issues as other jurisdictions regarding an ageing population and increased acute service use for the care of chronic conditions, in 2009 the Scottish government developed a national action plan for improving the health and wellbeing of people with long-term conditions.[378] The proposed approach was focussed on being person-centred, safe, effective, efficient, equitable and timely (Fig. 9.3).[378] Changes around self-management, condition management, and complex care for people with long-term conditions saw the rate of inpatient days for heart disease, diabetes, asthma, and COPD fall by 14% over a four-year period (2006-07 to 2010-11).[370]

Following from these successes, in 2011 the Scottish government committed £300 million over three years to a 'Change Fund', that was focussed on reshaping care for older people.[379] A key focus of the plan was on reducing the number of bed days used by older people as a result of emergency admissions.[380] Two years after the fund was introduced (2011-12), emergency bed days for those aged over 75 years had reduced by 6.8%.[380] In an effort to reduce demand for emergency care further, in 2015, the Scottish government committed another £300 million, over three years, on an 'Integrated Care Fund' aimed at providing integrated care to all adult care groups.[370] Changes are expected to focus on personal

outcomes, by adopting a co-production approach to address health literacy, and using technology to enable greater patient choice and control.[370] It has been acknowledged that one of the biggest challenges may be transforming the workforce to achieve the fund's aims. However, Hendy (the clinical lead for the project), and colleagues are hopeful that *growing recognition by all professions that the current paradigm is neither desirable nor sustainable offers a strong platform for the required transformation.*[370(p. 77)]

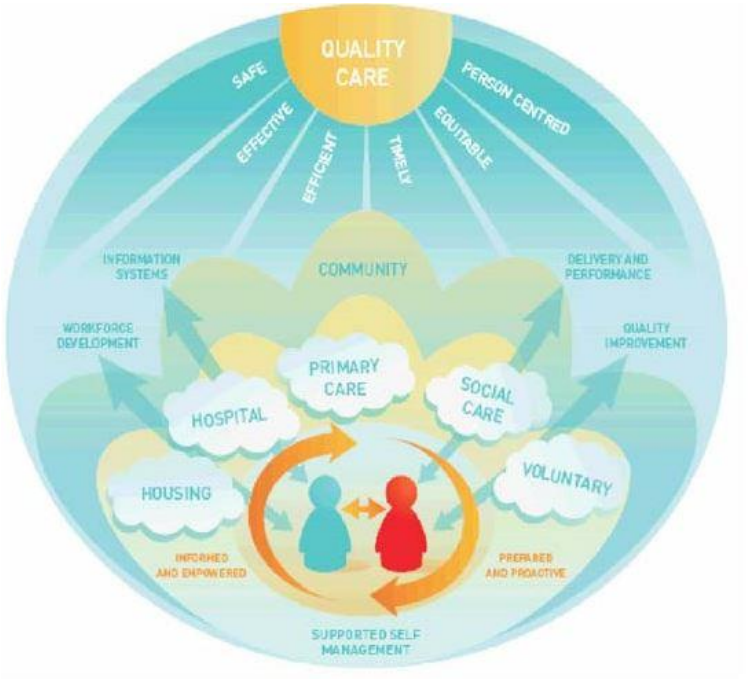

Figure 9.3 Scotland's mutual care model for long term conditions[378]

9.6 The Australian response to increased prevalence of chronic illness

With increasing pressure on the Australian healthcare system to provide quality, affordable and accessible health care, in 2015 the Australian federal government established the Primary Health Care Advisory Group (PHCAG). Its purpose was to provide advice on opportunities to reform the primary healthcare system. In 2016, the PHCAG submitted a report titled *Better outcomes for people with chronic and complex health conditions*, in which they stated that '*our current health system is not optimally set up to effectively manage long term conditions'*.[22(p.11)] Patient difficulties in accessing the system were also recognised, due to transport, language, mobility, geographical and financial barriers.[22] The current disjointed funding model, whereby the patient may need to access services from a range of

disconnected providers variously funded by the federal, state or local governments, as well as non-government organisations and private insurers, was identified as further adding to patient confusion and a lack of care continuity.[22]

The advisory group recommended the staged rollout of Health Care Homes (HCHs) in Australia, with the aim of providing more coordinated care for patients with chronic and complex conditions (Fig. 9.4).[22] The principles of the model focus on building a partnership between the patient and their preferred GP which puts the patient at the centre of their care, provides them with the knowledge and skills to self-manage, and enhances patients' access to services, thereby avoiding unnecessary ED presentations and hospital admissions.[22] The proposed funding model is via monthly bundled payments, based around three tiers of complexity. It is estimated that 46% of trial patients will be tier 1 (lowest complexity) and 9.5% in tier 3.[344]

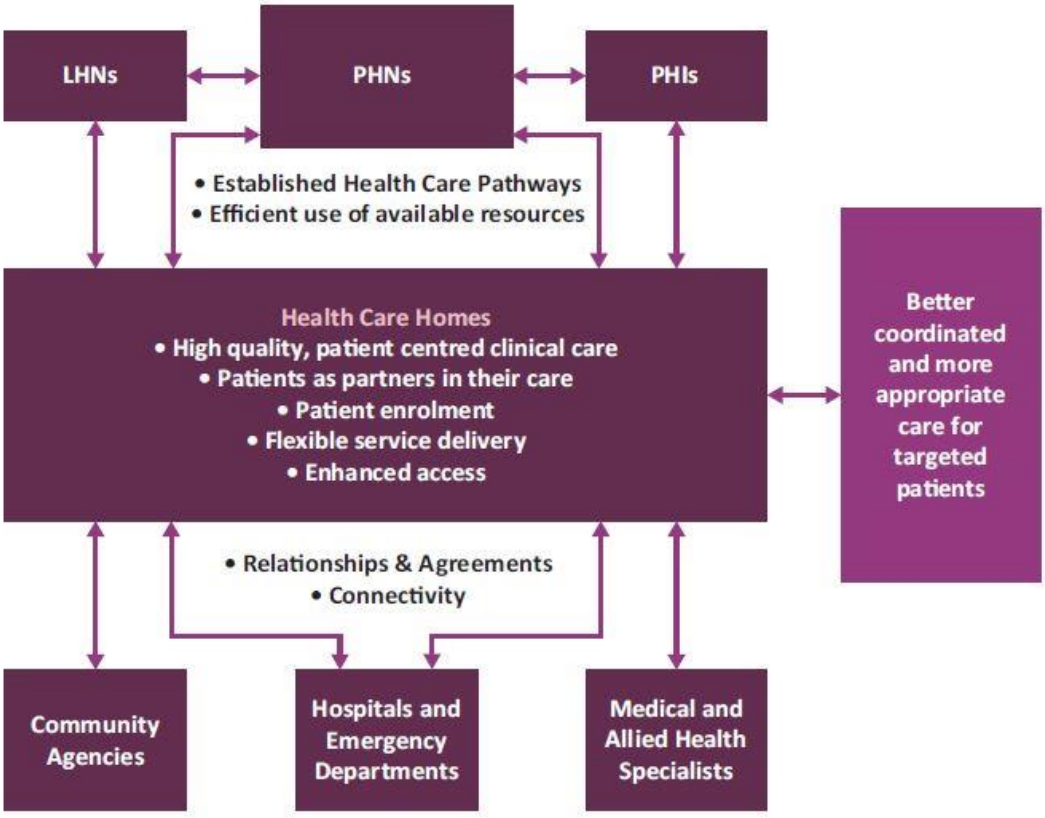

Figure 9.4 Proposed model of Australian Health Care Home[22]
LHN = Local hospital network PHN = Primary health network PHI = Private health insurers

9.6.1 The roll-out of the Health Care Homes trial

The announcement of the HCHs trial was well received by both the Australian Medical Association (AMA), and the Royal Australian College of General Practitioners (RACGP) (the academic college for GPs). In March 2016, the RACGP hailed the initiative as 'life-saving', particularly for those with chronic, long-term conditions.[381] However, as more details of the planned trial emerged, some of the initial support was lost. In November 2016, the RACGP issued a press release stating it was disappointed, after details about practice and patient eligibility, as well as payment systems for the HCHs, were released.[382] The AMA was also concerned about the proposed funding. Vice president Dr Tony Bartone stated the model could be at risk of falling over, due to being underfunded from the beginning.[383] He also suggested that if the model was to be successful, the government would need the goodwill of GPs.[383] Whilst the Commonwealth government had pledged to spend $21 million on infrastructure, training and evaluation, the RACGP stated that the average GP practice would require an extra $100,000 a year in funding to implement the HCH model.[384]

Another identified issue with the proposed model was the lack of integration of allied care services into the trial. Advisors to the government had suggested that funding for allied health should be given to the PHNs, who could then organise allied health care services in accordance with the plan of care drawn up by the GPs.[385] However, this did not happen. There was also some concern that the trial had been rushed, and that practices needed more time to ensure the tools introduced to support implementation were appropriate.[386] In a 2016 pre-budget submission to the Commonwealth government, the RACGP called for the federal government to commit extra funding to the HCHs trial, and to extend the trial period from two to five years.[387] They suggested that the proposed funding model was simply a reallocation of existing general practice payments, and therefore did not represent genuine investment in the trial.[387] The submission also expressed concerns that a two-year time period was not sufficiently long enough to allow for implementation and evaluation, and that overseas experience had shown that outcomes of the HCH model became more visible over time.[387]

As the roll-out commenced, and practices began to volunteer, concerns were raised that large, corporate practices were dominating the trial,[388] which was not a true reflection of the landscape of primary care in Australia. At the same time, fears were raised that, as bundled

payments were to be paid to practices rather than GPs, this could lead to larger tax bills for GPs.[389] This in turn led to some practices withdrawing from the trial.[390] In a statement in March this year (2018), Dr Steve Hambleton, who led the government's advisory panel on HCHs (and was a former AMA federal President), admitted that something went wrong in the roll-out of the trial. He stated that '*we had good government, good organised profession and good public engagement with the [advisory group] and then of course in the transition to implementation we clearly went wrong somewhere'.*[391] As of May this year (2018), only 2,000 patients had signed up to the HCH trial, far short of the 65,000 patients targeted.[392] Evaluation of phase one is due to commence in December 2019.[393] At the time of writing, there were more than 170 HCHs in operation across Australia.[279]

9.6.2 The immediate future of chronic care management in Australia

It is encouraging to note that the federal health minister, Greg Hunt, remains supportive of the HCHs trial. He has set up a taskforce, including the AMA and the RACGP, to look at redesigning the model.[394] There are many similarities between the proposed HCH model in Australia and the successful models of care described in Canterbury, Bridgepoint and Scotland. All three models involved placing the patient at the centre of the system and providing coordinated care to enable patients with chronic conditions to effortlessly navigate an often-fragmented healthcare system. The main point of difference appears to be that whereas Canterbury, Bridgepoint, and Scotland undertook a whole-of-system approach to integrate care, and change the interface between primary and acute care, the HCH model seems to put the onus solely on the primary care sector, most notably GPs, to drive the change. The successful models described previously indicate that the proposed task force should focus on revising the HCH model to include a whole-of-system approach, involving clinicians from all sectors and professions of the healthcare system. Similar to the Canterbury model, clinicians from all sectors should work together to devise localised strategies for the management of acute exacerbations of chronic conditions, which include admission avoidance strategies. Some of this work is already underway, with Primary Health Tasmania (PHT) working with local clinicians to produce Tasmanian HealthPathways.[395] However, still more needs to be done.

In September of this year (2018), a roundtable between The George Institute for Global Health, the Consumer Health Forum of Australia and The University of Queensland, devised a

blueprint for HCHs version 2.0.[396] The group recognised that the HCH model provided a *great opportunity for transformational reform in the Australian health system*.[396(p. 8)] The objective of the roundtable was to develop recommendations about how Australia could move towards a strengthened primary care system. One of the groups key recommendations was the importance of addressing the current funding barriers.[396] The group proposed continuing with a revised model of the HCH model, with a shift away from fee-for-service payment systems. They suggested that Commonwealth, state and territory funding should be combined, and jointly administered by PHNs and LHNs, who in turn should prioritise prevention and integrated primary health care.[396] The report also recommended the creation of local solutions, and involving consumers in codesign to support shared decision-making.[396] The necessity of promoting team-based care, and ensuring the funding model supported joined-up models of health service delivery across primary, secondary and tertiary sectors, was also highlighted.[396]

It seems that, if the HCH model of care is to enjoy any level of success, it is crucial for governments and the primary care sector to work together to ensure the proposed model of funding is agreeable to all. The importance of active clinician involvement at every stage has been previously cited as crucial for the initiative's success.[397] It is encouraging to see that both the AMA and the RACGP are to be involved in the taskforce set up to redesign the HCH model.[394] The importance of ensuring that the model of funding is correct has also been stressed as vitally important by those involved in the Bridgepoint initiative,[366] those evaluating the Canterbury model,[372] and others who have sought to advise the Australian government on how best to ensure the success of the HCH trial.[344, 398] Although the roll-out of the HCH trial has not been without its difficulties, it appears that there remains many supporters of the model. Even when acknowledging that there had been issues with the trials roll-out, Dr Hambleton stated '*for goodness sake, nobody disagrees with the model of care*'.[391] As another champion of the HCH model, Dr Frank Jones (former President of the RACGP) described it, the HCH is '*a moment in time to change how the healthcare system works in Australia'.*[399]

9.6.3 Health care homes and patient-perceived access to care

Viewed through the lens of the domains of access to care, the HCH model can be seen to address many of the issues identified in phase four (Chapter 8) of the current study. The HCH

promises to: be patient-centred, with care tailored to the needs of the individual; be coordinated and comprehensive; ensure timely and equitable access to care; increase patients' skills and knowledge to enable them to be partners in, and self-manage their care; and be no more costly to the patient then their current care arrangements.[400]

Once enrolled in a HCH, patients will be made aware of the services available to them, how and when to access these services, and be able to obtain an appointment in a timely manner, thereby alleviating any issues regarding the domain of availability and accommodation.[225, 228] Patients in the trial will work with their care team to devise and agree upon an individualised plan of care. This will ensure that the individual's beliefs about health and illness are taken into consideration, as well as ensuring that the patient is aware of the benefits to them in accessing healthcare services. This should also build trust between the patient and their care team (domain of approachability).[228] As the patient nominates a preferred GP, who then becomes the 'leader' of the patients care team, it is likely that patients will choose providers with whom they have shared attitudes and beliefs (domain of acceptability).[225, 228] The issue of health literacy will be addressed by ensuring patients are educated about their health conditions. Patients will be encouraged to be involved in decisions about their care, and taught the skills and knowledge required to enable them to become true partners in the provision of their care. The patient's care will be provided by a dedicated team of professionals, led by the patient's nominated GP, thereby ensuring continuity of care (domain of appropriateness).[228] Finally, the HCH model of care will not involve any additional out-of-pocket expenses for the patient (domain of affordability).[225, 228]

This research identified a link between patient-perceived access to care and increased ED presentations and subsequent hospitalisations by elderly patients in the south of Tasmania. It appears that the problem of ED crowding may be merely a symptom of issues within the broader system. As suggested by Vassar, the ED waiting room is 'a room with a view' of the overall healthcare system.[401] The HCH model of care appears to have the potential to address the majority of the issues identified as contributing to increased ED utilisation by elderly patients with chronic conditions in this region. Therefore, it is essential that clinicians and administrators from all sectors of the healthcare system work collaboratively, to ensure the trial has the best opportunity to succeed. As other regions have shown, when a whole-of-system approach to integrating care for those with chronic and complex conditions is

undertaken, it is possible to reduce ED presentations and subsequent hospital admissions, thereby reducing stress on the acute care system, and providing real person-centred care.

9.7 Limitations

This study is not without limitations.

- The state-wide analysis of ED presentations identified wide-ranging regional variations in patterns of ED utilisation across the state. Although the greatest identified increase in presentations over the four-year period was in the south of the state, per capita presentations in the South started from a lower base rate than the other two regions (Fig. 4.1).[89] As one of the aims of this project was to investigate the drivers of ED utilisation, we decided to focus our investigation into identifying what was behind the large identified increases in the South. This did not explain the decreases identified in the NW nor the smaller increases in the North. However, other groups in Tasmania's North[203, 402] and NW,[188, 200] are investigating ED demand in these regions.
- Phase two involved a retrospective data analysis of six-years of inpatient data at the RHH. The aim was to analyse admissions by those aged ≥ 75 years, to try to explain the increases in ED utilisation by this patient population identified in phase one. However, approximately 70% of all patients aged ≥ 75 who presented to the ED were admitted, leaving as yet unexplained the drivers behind ED utilisation by those elderly patients who were discharged post-ED treatment.
- The plan for phase four of this thesis had been to interview six participants to explore the journey that had led to their short-stay CCF admission. However, recruitment of participants proved to be problematic. The requirement of the ethics committee to protect interview participants from feeling coerced into taking part, meant that the researcher could not approach potential participants directly. Whilst the recruitment nurses endeavoured to consent suitable candidates, they seemingly struggled to find participants that met all of the inclusion criteria. In retrospect, perhaps more could have been done to improve the recruitment process. If the researcher had had ethical clearance to access ED and inpatient data bases, perhaps a greater number of potential participants would have been identified, and in a timelier manner. Likewise, it may have proved beneficial to include medical staff involved in assessing and admitting these types of patients in the recruitment process.

However, with the many different research projects being undertaken in health facilities at any given time, it was felt that this had the potential to overburden medical staff.

The sequential design used in this study meant that it was not evident that interviews would be undertaken, nor who would be interviewed, until two years into the study. This led to a delay in applying for ethical consent to recruit participants. Subsequently, the difficulties encountered by the recruitment nurses in identifying suitable participants, and the timelines of the project meant that ultimately only four patients were interviewed. Nevertheless, the similarities between participants' experiences reinforce the likelihood that other elderly patients with chronic conditions in the region experience similar difficulties when trying to manage an acute exacerbation of their chronic condition.

- While incorporating comprehensive data analyses and interviews with patients, the voice of clinicians is absent from this thesis. At the completion of phase one (state-wide ED data analysis) the results were presented to two of the three Tasmanian regional ED medical directors, as well as the CEO of PHT. All three offered insights into what they thought may be driving increased ED utilisation by the elderly in the South, compared to the other two regions. Suggestions included the increase in the number of elderly patients who reside in their own home versus a RACF, the difference in 'types' of GP in the more rural North and North-West of the state (older, and more willing to visit the patient in their own home) versus the younger, more 'nine-to-five' orientated GP in the state's South, and the belief that, although there were increases in ED presentations in the South, all patients who attended the ED had attended the correct facility for their health care requirements. Due to the timeframe of the study, there was no further input from clinicians into the research. However, the experiences of the interview participants, coupled with the results of the data analyses provide evidence that patient-perceived access to care is one driver of increased ED utilisation and subsequent hospital admission by the elderly in this region.

9.8 Recommendations

Tasmania has been identified as having high rates of chronic disease, the highest mean age of all Australian states and territories, a large proportion of its population living in areas designated as socioeconomically disadvantaged, as well as all of the state being classified as either regional or remote. All of these have been identified as factors that make it more likely a person will attend an ED. Therefore, although this project was local to the island state of

Tasmania, the findings have relevance for other healthcare jurisdictions, both nationally and internationally, struggling with the issue of ED crowding.

- As both the systematic review of the international literature and the state-wide analysis of ED presentations undertaken as part of this study highlighted, the drivers of ED utilisation are likely to be contextually specific. Therefore, it would be prudent to undertake an investigation of the drivers of ED utilisation in a given region before embarking on potentially costly solutions, that may not address specific local causes. This investigation could take the form of a retrospective data analysis of recent ED presentations, as this would address the question of where ED presentations are increasing (specific regions), as well as potentially identifying specific cohorts of patients driving increased demand. Analysis could also include surveying or interviewing local ED users to gain their insights into why they attended the ED for their health care needs. As results of this thesis have suggested, ensuring that initiatives introduced to combat increased ED attendances are patient focussed is crucial to a schemes' success. Therefore, designing solutions without first understanding, from the patient's perspective, why they attend the ED, would appear unwise.
- This research identified a link between ED utilisation by the elderly with chronic conditions and perceived access to care. The HCH model appears to be consistent with elements of overseas models that have been successful in reducing demand for acute care services by putting the patient at the centre of the system. Identified key elements of successful models include all sectors of the system working together to achieve a whole-of-system redesign, incorporating local ways-of-working into new models of care, and ensuring the model of funding is such that it encourages all clinicians to provide the right service, to the right client, in the right location, and at the right time. As discussed in the introduction of this thesis (Chapter 1), the funding of healthcare in Australia is complicated, with various sectors of government involved in funding different, but overlapping, sectors of the system. It has been acknowledged that this has led to suggestions of 'cost-shifting' between sectors.[44] If the HCH model of care is to be a success, it is crucial that federal, state and territory governments work collaboratively with local clinicians, across sectors, to design a person-centred model that is agreeable to all. This is achievable if all involved are willing to genuinely put the patient at the centre of their decision making.

  Careful evaluation of the HCH model, ensuring the perspective of the patients involved in the trial is also recommended, to ensure that any future model is designed with a truly

person-centred focus. A realist evaluation method could provide an understanding of which aspects of the model worked for whom, and why (and vice versa), thereby ensuring that any future design of the model incorporates the most positive and well received aspects of the trial.

- This thesis has reported on the results of four interviews undertaken with elderly residents of the region who had recently experienced a short-stay admission for CCF. Although all of the participants reported similar experiences, it is recommended that further interviews be undertake with a larger sample to explore the extent of the issues identified. As phase two identified that elderly patients with CCF were the greatest contributor to short-stay PPHs in this region, this cohort of patients were targeted for interview. However, it is recommended that similar interviews are undertaken with elderly patients experiencing short-stay admissions for a range of conditions considered potentially avoidable (e.g. COPD, diabetes), to explore similarities and/or differences in accessing care outside of the acute sector. Bearing in mind the difficulties faced in this project as regards recruitment of suitable participants, it is recommended that different strategies are considered. This could include involving GPs or specialist outpatient clinics, or advertising in local newspapers.
- As the majority of patient care for chronic conditions is provided in the primary care sector, future research into patient-perceived access to care in the community should involve this sector. Potential studies could involve interviewing the patient and their preferred GP, to assess for differences in perceptions as to the availability of services. Similarly, involving ED and chronic care clinicians in future research studies could provide insights into the factors behind patients stated lack of knowledge about their chronic condition and absence of education to enable self-management.
- Finally, the sequential exploratory design used in this thesis enabled an in-depth understanding of who was contributing to increased ED presentations in this region, as well as the specific, patient-level factors driving ED utilisation. The initial broad data analysis gave a comprehensive insight into regional variations in patterns of ED utilisation, as well as highlighting the elderly with chronic conditions as an emerging driver of ED presentations. The qualitative exploration of elderly patient's views regarding perceived access to care in the community, provided rich insights into the barriers faced by this cohort of patients when trying to manage their chronic conditions. Therefore, it is recommended that this research design be incorporated into future health services research, particularly those focussed on

gaining a detailed understanding of both who and why people choose to utilise a particular service.

9.9 Conclusion

There is no question that the population of the world is ageing, bringing with it an increase in patients with complex and chronic conditions. Healthcare systems worldwide are struggling to cope with identified changes in health service utilisation. There is recognition amongst governments, policymakers and clinicians that health systems need to modify their approaches to the delivery of care to effectively manage the increasing demand for acute services.

This research aimed to examine temporal and regional patterns in hospital ED presentations in Tasmania, and subsequently investigate the factors driving ED utilisation. A link was identified between patient-perceived access to care and increased ED presentations and subsequent hospitalisations by elderly patients in the south of the state. The Healthcare Home model of care appears to potentially address all of the issues identified as contributing to these increases.

The findings of this thesis demonstrate that increased ED utilisation is a manifestation of issues within the broader healthcare system. Results highlight the difficulties faced by elderly residents in the south of the state when trying to access care outside the acute care sector. As depicted in Haggerty's flowchart of a typical care-seeking trajectory (Fig. 5.4), when people experience barriers in accessing health care in the community, they frequently end up in the ED. There is research evidence that points to positive outcomes for patients and systems alike when whole-of-system, person-centred approaches are undertaken to provide coordinated and integrated care for those with complex and chronic conditions. Findings from this research provide evidence that it is imperative that governments and all areas of the Australian healthcare sector unify their efforts to provide genuine, person-centred care, and thereby potentially alleviate the seemingly unsustainable demand for acute care services.

References

1. Hoot NR, Aronsky D. Systematic review of emergency department crowding: causes, effects, and solutions. Ann Emerg Med. 2008;52(2):126-36.

2. Australasian College for Emergency Medicine. Statement on emergency department overcrowding Melbourne, Australia: ACEM; 2006 [updated July 2011; cited 2018 February 13th]. Available from: https://acem.org.au/getmedia/dd609f9a-9ead-473d-9786-d5518cc58298/S57-Statement-on-ED-Overcrowding-Jul-11-v02.aspx.

3. Pines JM, Hollander JE. Emergency department crowding is associated with poor care for patients with severe pain. Ann Emerg Med. 2008;51(1):1-5.

4. Sikka R, Mehta S, Kaucky C, Kulstad EB. ED crowding is associated with an increased time to pneumonia treatment. Am J Emerg Med. 2010;28:809-12.

5. Medley DB, Morris JE, Stone CK, Song J, Delmas T, Thakrar K. An association between occupancy rates in the emergency department and rates of violence toward staff. J Emerg Med. 2012;43(4):736-44.

6. Sun BC, Hsia RY, Weiss RE, Zingmond D, Liang LJ, Han W, et al. Effect of emergency department crowding on outcomes of admitted patients. Ann Emerg Med. 2013;61(6):605-11 e6.

7. Verelst S, Wouters P, Gillet J-B, Van den Berghe G. Emergency department crowding in relation to in-hospital adverse medical events: a large prospective observational cohort study. J Emerg Med. 2015;49(6):949-61.

8. Asplin BR, Magid DJ, Rhodes KV, Solberg LI, Lurie N, Camargo CA, Jr. A conceptual model of emergency department crowding. Ann Emerg Med. 2003;42(2):173-80.

9. Arain M, Campbell MJ, Nicholl JP. Impact of a GP-led walk-in centre on NHS emergency departments. Emerg Med J. 2015;32(4):295-300.

10. Dolton P, Pathania V. Can increased primary care access reduce demand for emergency care? Evidence from England's 7-day GP opening. J Health Econ. 2016;49:193-208.

11. Sullivan CM, Staib A, Flores J, Aggarwal L, Scanlon A, Martin JH, et al. Aiming to be NEAT: safely improving and sustaining access to emergency care in a tertiary referral hospital. Aust Health Rev. 2014;38(5):564-74.

12. Copeland J, Gray A. A daytime fast track improves throughput in a single physician coverage emergency department. CJEM 2015;17(6):648-55.

13. Howell E, Bessman E, Kravet S, Kolodner K, Marshall R, Wright S. Active bed management by hospitalists and emergency department throughput. Ann Intern Med. 2008;149(11):804-10.

14. Quinn JV, Mahadevan SV, Eggers G, Ouyang H, Norris R. Effects of implementing a rapid admission policy in the ED. Am J Emerg Med. 2007;25(5):559-63.

15. Secretary of State for Health (UK). The NHS plan. A plan for investment. A plan for reform. Norwich, UK: NHS; 2000 [Available from: http://webarchive.nationalarchives.gov.uk/20121102184216/http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4002960.

16. Jones P, Wells S, Harper A, Le Fevre J, Stewart J, Curtis E, et al. Impact of a national time target for ED length of stay on patient outcomes. NZMJ. 2017;130(1455):15-34.

17. Tenbensel T, Chalmers L, Jones P, Appleton-Dyer S, Walton L, Ameratunga S. New Zealand's emergency department target - did it reduce ED length of stay, and if so, how and when? BMC Health Serv Res. 2017;17.

18. Sullivan C, Staib A, Eley R, Scanlon A, Flores J, Scott I. National Emergency Access Targets metrics of the emergency department-inpatient interface: measures of patient flow and mortality for emergency admissions to hospital. Aust Health Rev. 2015.

19. Perera ML, Gnaneswaran N, Roberts MJ, Giles M, Liew D, Ritchie P, et al. The 'four-hour target' and the impact on Australian metropolitan acute surgical services. ANZ journal of surgery. 2016;86(1-2):74-8.

20. Care Quality Commission. Under pressure. Safely managing increased demand in emergency departments. Newcastle-upon-Tyne, UK; 2018.

21. Primary Health Tasmania. After Hours Practice Funding Scheme (AHPFS). Final Report. Hobart: PHN Tasmania; 2016.

22. Primary Health Care Advisory Group. Better outcomes for people with chronic and complex health conditions. Canberra, Australia: Commonwealth of Australia; 2016.

23. Lawton JK, Kinsman L, Dalton L, Walsh F, Bryan H, Williams S. Right service, right place: optimising utilisation of a community nursing service to reduce planned re-presentations to the emergency department. BMJ Open Quality. 2017;6(2):e000150.

24. Tasmanian Health Service. Community Rapid Response Service. In: THS, editor. Hobart, Tasmania: Tasmanian Government; 2016.

25. Prestwood M. Hospital avoidance: collaborating to improve patient and system outcomes. Celebrating the Extraordinary; March 1st 2019; Hobart, Tasmania.

26. Pines JM, Griffey RT. What we have learned from a decade of ED crowding research? Acad Emerg Med. 2015;22(8):985-7.

27. NHS Digital. Hospital Accident and Emergency Activity, 2016-17 London: NHS Digital; 2017 [Available from: https://digital.nhs.uk/data-and-information/publications/statistical/hospital-accident--emergency-activity/2016-17.

28. Guttmann A, Schull MJ, Vermeulen MJ, Stukel TA. Association between waiting times and short term mortality and hospital admission after departure from emergency department: population based cohort study from Ontario, Canada. BMJ. 2011;342:d2983.

29. Eitel DR, Rudkin SE, Malvehy MA, Killeen JP, Pines JM. Improving service quality by understanding emergency department flow: a white paper and position statement prepared for the American Academy of Emergency Medicine. J Emerg Med. 2010;38(1):70-9.

30. Chen LC, Lin CC, Han CY, Hsieh CL, Wu CJ, Liang HF. An interpretative study on nurses' perspectives of working in an overcrowded emergency department in Taiwan. Asian Nursing Research. 2018;12(1):62-8.

31. Jayaprakash N, O'Sullivan R, Bey T, Ahmed SS, Lotfipour S. Crowding and delivery of healthcare in emergency departments: the European perspective. West J Emerg Med. 2009(4):233-9.

32. FitzGerald G, Toloo S, Rego J, Ting J, Aitken P, Tippett V. Demand for public hospital emergency department services in Australia: 2000-2001 to 2009-2010. Emerg Med Australas. 2012;24(1):72-8.

33. Australian Institute of Health and Welfare. Australia's health 2018. Canberra: AIHW; 2018.

34. The Commission on Delivery of Health Services in Tasmania. Working towards a sustainable health system in Tasmania. Canberra: Commonwealth of Australia; 2014.

35. Department of Health and Human Services. Rebuilding Tasmania's Health System — Supplement No.4 – Emergency Care. In: DHHS, editor. Hobart 2015.

36. Health Services Innovation Tasmania. Working together to improve Tasmanian healthcare delivery Hobart, Tasmania: HSI. Tas.; 2017 [Available from: http://www.healthinnovation.tas.edu.au/home.

37. Department of Health and Human Services. Delivering safe and sustainable clinical services. Tasmania: Department of Health and Human Services; 2015.

38. Lawler J, Allen T, Huckerby E, Bradley T. Challenges, insights and successes with redesign in ED at RHH. Emergency Tasmania 2016; 2016; Launceston, Tasmania

39. Willis E, Reynolds L, Keleher H. Understanding the Australian health care system. Chatswood, NSW: Elsevier; 2012.

40. Australian Institute of Health and Welfare. Admitted patient care 2015-16. Canberra, Australia: AIHW; 2017.

41. Willis E, Reynolds L, Keleher H. Understanding the Australian health care system. Third ed. Chatswood, NSW, Australia: Elsevier; 2016.

42. Willis E, Parry Y. The Australian health care system. 2012. In: Understanding the Australian health care system [Internet]. Chatswood, NSW: Elsevier. Second.

43. Australian Institute of Health and Welfare. Australia's health 2018: in brief. Canberra: AIHW; 2018.

44. Swerissen H, Duckett S, Moran G. Mapping primary care in Australia. Victoria, Australia: Grattan Institute; 2018.

45. Council of Australian Governments. National health reform agreement. In: Department of Health, editor. Canberra: Commonwealth of Australia; 2011.

46. Australian Bureau of Statistics. 3101.0 - Australian Demographic Statistics, Jun 2017 Canberra: ABS; 2017 [updated 14 Decemeber 2017; cited 2018 January 23rd]. Available from: http://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/3101.0Feature%20Article1Jun%202017?opendocument&tabname=Summary&prodno=3101.0&issue=Jun%202017&num=&view=.

47. Tasmanian Medicare Local. Primary Health Indicators Tasmania Report Hobart: Tasmanian Medicare Local Limited; 2015.

48. 3218.0 - Regional Population Growth, Australia, 2013-14 [Internet]. 2016 [cited 17 November 2016]. Available from: http://www.abs.gov.au/AUSSTATS/abs@.nsf/Previousproducts/3218.0Main%20Features452013-14?opendocument&tabname=Summary&prodno=3218.0&issue=2013-14&num=&view=.

49. Department of Health and Human Services. Rebuilding Tasmania's Health System Issues Paper. Hobart: Government of Tasmania; 2015.

50. Tasmanian Health Service. Tasmanian Clinical Services Profile Implementation Plan. Hobart: Tasmanian Government; 2015.

51. Australian Institute of Health and Welfare. Emergency department care 2016–17: Australian hospital statistics. Canberra, Australia: AIHW; 2017. Contract No.: HSE 194.

52. Australian Institute of Health and Welfare. Emergency department care 2015-16; Australian hospital statistics. Canberra: AIHW; 2016. Contract No.: HSE 182.

53. Mulrow CD. Rationale for systematic reviews. BMJ. 1994;309:597-9.

54. Creswell JD, Plano Clark LV. Designing and conducting mixed methods research. Second ed. Thousand Oaks, California: Sage; 2011.

55. Campbell DT, Fiske DW. Convergent and discriminate validation by the multitrait-multimethod matrix. Psychological Bulletin. 1959;56(2):81-105.

56. Johnson RB, Onwuegbuzie AJ, Turner LA. Toward a definition of mixed methods research. J Mix Methods Res. 2007;1(2):112-33.

57. Creswell JW, Plano Clark VL. Designing and conducting mixed methods research. California: Sage; 2018.

58. Johnson RB, Onwuegbuzie AJ. Mixed Methods Research: a research paradigm whose time has come. Educational Researcher. 2004;33(7):14-26.

59. Tashakkori A, Teddie C. Current developments and emerging trends in integrated research methodology. In: Tashakkori A, Teddie C, editors. Mixed methods in social and behavioural science. Second ed. Thousand Oaks, CA: Sage; 2010. p. 803-26.

60. Simons L, Lathlean J. Mixed Methods. In: Gerrish K, Lacey A, editors. The research process in nursing. Sixth ed. Oxford, UK: Wiley-Blackwell; 2010. p. 331-42.

61. Parahoo K. Nursing research. Princlples, process and issues. Third ed. Hampshire, UK: Palgrave MacMillan; 2014.

62. Greenhalgh TM. Understanding research methods for evidence-based practice in health. Melbourne, Australia: Wiley; 2016. Available from: http://ebookcentral.proquest.com/lib/utas/detail.action?docID=4748116.

63. Walsh K. Quantitative vs qualitative research: a false dichotomy. Journal of Research in Nursing. 2012;17(1):9-11.

64. Howe KR. Against the quantitative-qualitative incompability thesis or dogma die hard authors. Educational Researcher. 1988;17(8):10-6.

65. Feilzer MY. Doing mixed methods research pragmatically: implications for the rediscovery of pragmatism as a research paradigm. J Mix Methods Res. 2010;4(1):6-16.

66. Leech NL. Interviews with the early developers of mixed methods research. In: Tashakkori A, Teddie C, editors. Mixed methods in social and behavioural science. Second ed. Thousand Oaks, CA: Sage; 2010. p. 253-72.

67. Grix J. Introducing students to the generic terminology of social research. Politics. 2002;22(3):175-86.

68. Gorard S. Research design, as independent of methods. In: Tashakkori A, Teddie C, editors. Mixed methods in social and behavioural research. Second ed. Thousand Oaks, CA: Sage; 2010. p. 237-74.

69. Greene JC, Caracelli VJ, Graham WF. Toward a conceptual framework for mixed-method evaluation designs. Educational Evaluation and Policy Analysis. 1989;11(3):255-74.

70. Tashakkori A, Teddie C. Handbook of mixed methods in social and behavioural research. Tashakkori A, Teddie C, editors. Thousand Oaks, CA: Sage; 2003.

71. Johnson RB. Toward a more inclusive scientific research in education. Educational Researcher. 2009;38:449-57.

72. Scott PJ, Briggs JS. A pragmatist argument for mixed methodology in medical informatics. J Mix Methods Res. 2009;3(3):223-41.

73. Biesta G. Pragmatism and the foundations of mixed methods research. In: Tashakkori A, Teddie C, editors. Mixed methods in social and behavioural research. Second ed. Thousand Oaks, CA: Sage; 2010. p. 95-117.

74. Morgan DL. Pragmatism as a paradigm for social research. Qualitative Inquiry. 2014;20(8):1045-53.

75. Morgan Dl. Paradigms lost and pragmatism regained. Methodological implications of combining qualitative and quantitative methods. J Mix Methods Res. 2007;1(1):48-76.

76. Bryman A. Why do researchers integrate/combine/mesh/blend/mix/merge/fuse quantitative and qualitative research? In: Bergman MM, editor. Advances in mixed methods research. London, UK: Sage; 2008. p. 87-100.

77. Tashakkori A, Teddie C. Quality of inferences in mixed methods research: calling for an integrative framework. In: Bergman MM, editor. Advances in mixed methods research. London, UK: Sage; 2008. p. 101-19.

78. Creswell JW. Research design. Qualitative, quantitative, and mixed methods approaches. Second ed. California: Sage; 2003.

79. Teddlie C, Tashakkori A. Foundations of mixed methods research: integrating quantitative and qualitative approached in the social and behavioural sciences. Thousand Oaks, CA: Sage; 2009.

80. Greene JC. Mixed methods in social inquiry. San Francisco, CA: Jossey-Bass; 2007.

81. Morse JM, Niehaus L. Mixed methods design: princliples and procedures. Walnut Creek, CA: Sage; 2009.

82. Creswell JW, Plano Clark VL, Gutmann M, Hanson W. Advanced mixed methods research designs. In: Tashakkori A, Teddie C, editors. Handbook of mixed methods in social and behavioral research. Thousand Oaks, CA: Sage; 2003. p. 209-40.

83. Guest G. Describing mixed methods research. J Mix Methods Res. 2012;7(2):141-51.

84. Morse JM. Principles of mixed methods and multimethod research design. In: Tashakkori A, Teddie C, editors. Handbook of mixed methods in social and behavioural research. Thousand Oaks, CA: Sage; 2003. p. 189-208.

85. Bazeley P. Integrating data analyses in mixed methods research. J Mix Methods Res. 2009;3(3):203-7.

86. Ivankova NV, Cresswell JW, Stick SL. Using mixed-methods sequential explanatory design: from theory to practice. Field Methods. 2006;18(1):3-20.

87. Plunkett PK. Blocked, bothered and bewildered am I. Eur J Emerg Med. 2006;13(2):65-6.

88. Dinh MM, Bein KJ, Latt M, Chalkley D, Muscatello D. Age before acuity: the drivers of demand for emergency department services in the greater Sydney area. Emerg Med J. 2015;32(9):708-11.

89. Morley C, Stankovich J, Peterson G, Kinsman L. Planning for the future: emergency department presentation patterns in Tasmania, Australia. Int Emerg Nurs. 2018;38:34-40.

90. Lowthian JA, Curtis AJ, Jolley DJ, Stoelwinder JU, McNeil JJ, Cameron PA. Demand at the emergency department front door: 10-year trends in presentations. Med J Aust. 2012;196(2):128-32.

91. LaCalle E, Rabin E. Frequent users of emergency departments: the myths, the data, and the policy implications. Ann Emerg Med. 2010;56(1):42-8.

92. Richardson DB, Mountain D. Myths versus facts in emergency department overcrowding and hospital access block. Med J Aust. 2009;190(7):369-74.

93. Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. BMJ. 2009;339:b2535.

94. Jones P, Wells S, Ameratunga S. Towards a best measure of emergency department crowding: lessons from current Australasian practice. Emerg Med Australas. 2017;30(2):214-21.

95. Hwang U, McCarthy ML, Aronsky D, Asplin B, Crane PW, Craven CK, et al. Measures of crowding in the emergency department: a systematic review. Acad Emerg Med. 2011;18(5):527-38.

96. Shenoi RP, Ma L, Jones J, Frost M, Seo M, Begley CE. Ambulance diversion as a proxy for emergency department crowding: the effect on pediatric mortality in a metropolitan area. Acad Emerg Med. 2009;16(2):116-23.

97. Critical Apprasial Tools / Checklists [Internet]. 2012 [cited August 2016]. Available from: http://www.sign.ac.uk/checklists-and-notes.html.

98. Morley C, Unwin M, Peterson G, Stankovick J, Kinsman L. The consequences and causes of, or solutions to, emergency department crowding: a systematic review protocol. PROSPERO 2017 CRD42017073439 2017 [Available from: https://www.crd.york.ac.uk/PROSPERO/display_record.php?RecordID=73439.

99. Kulstad EB, Sikka R, Sweis RT, Kelley KM, Rzechula KH. ED overcrowding is associated with an increased frequency of medication errors. Am J Emerg Med. 2010;28(3):304-9.

100. Lee CC, Lee NY, Chuang MC, Chen PL, Chang CM, Ko WC. The impact of overcrowding on the bacterial contamination of blood cultures in the ED. Am J Emerg Med. 2012;30(6):839-45.

101. van der Linden MC, Khursheed M, Hooda K, Pines JM, van der Linden N. Two emergency departments, 6000 km apart: differences in patient flow and staff perceptions about crowding. Int Emerg Nurs. 2017;35:30-6.

102. Jarvis P, Davies T, Mitchell K, Taylor I, Baker M. Does rapid assessment shorten the amount of time patients spend in the emergency department? . British Journal of Hospital Medicine. 2014;15(11):648-51.

103. Kelen GD, Scheulen JJ, Hill PM. Effect of an emergency department (ED) managed acute care unit on ED overcrowding and emergency medical services diversion. Acad Emerg Med. 2001;8(11):1095-100.

104. Shetty A, Gunja N, Byth K, Vukasovic M. Senior streaming assessment further evaluation after triage zone: a novel model of care encompassing various emergency department throughput measures. Emerg Med Australas. 2012;24:374-82.

105. Chang AM, Cohen DJ, Lin A, Augustine J, Handel DA, Howell E, et al. Hospital strategies for reducing emergency department crowding: a mixed-methods study. Ann Emerg Med. 2018;71(4):497-505.

106. Holroyd BR, Bullard MJ, Latoszek K, Gordon D, Allen S, Tam S, et al. Impact of a triage liaison physician on emergency department overcrowding and throughput: a randomized controlled trial. Acad Emerg Med. 2007;14(8):702-8.

107. Jang JY, Shin SD, Lee EJ, Park CB, Song KJ, Singer AJ. Use of a comprehensive metabolic panel point-of-care test to reduce length of stay in the emergency department: a randomized controlled trial. Ann Emerg Med. 2013;61(2):145-51.

108. Begaz T, Elashoff D, Grogan TR, Talan D, Taira BR. Initiating diagnostic studies on patients with abdominal pain in the waiting room decreases time spent in an emergency department bed: a randomized controlled trial. Ann Emerg Med. 2017;69(3):298-307.

109. Douma MJ, Drake CA, O'Dochartaigh D, Smith KE. A pragmatic randomized evaluation of a nurse-initiated protocol to improve timeliness of care in an urban emergency department. Ann Emerg Med. 2016;68(5):546-52.

110. Bond K, Ospina MB, Blitz S, Afilalo M, Campbell SG, Bullard M, et al. Frequency, determinants and impact of overcrowding in emergency departments in Canada. Healthcare Quarterly. 2007;10(4):32-40.

111. Derlet RW, Richards JR. Emergency department crowding in Florida, New York, and Texas. Southern Medical Journal. 2002;95(8):846-9.

112. Estey A, Ness K, Saunders DL, Alibhai A, Bear RA. Understanding the causes of overcrowding in emergency departments in the Capital Health Region in Alberta: a focus group study. CJEM. 2003;5(2):87-94.

113. Anantharaman V. Impact of health care system interventions on emergency department utilization and overcrowding in Singapore. Int J Emerg Med. 2008;1(1):11-20.

114. Arya R, Wei G, McCoy JV, Crane J, Ohman-Strickland P, Eisenstein RM. Decreasing length of stay in the emergency department with a split emergency severity index 3 patient flow model. Acad Emerg Med. 2013;20(11):1171-9.

115. Asha SE, Ajami A. Improvement in emergency department length of stay using a nurse-led 'emergency journey coordinator': a before/after study. Emerg Med Australas. 2014;26(2):158-63.

116. Barrett L, Ford S, Ward-Smith P. A bed management strategy for overcrowding in the emergency department. Nursing Economics. 2012;30(2):82-5.

117. Buckley DJ, Curtis PW, McGirr JG. The effect of a general practice after-hours clinic on emergency department presentations: a regression time series analysis. Health Care. 2010;192(8):448-51.

118. Burke JA, Greenslade J, Chabrowska J, Greenslade K, Jones S, Montana J, et al. Two hour evaluation and referral model for shorter turnaround times in the emergency department. Emerg Med Australas. 2017;29(3):315-23.

119. Burley G, Bendyk H, Whelchel C. Managing the storm: an emergency department capacity strategy. Journal for Healthcare Quality. 2007;29(1):19-28.

120. Burstrom L, Engstro M-L, Castren M, Wiklund T, Enlund M. Improved quality and efficiency after the introduction of physician-led team triage in an emergency department. Upsala Journal of Medical Sciences. 2016;121(1):38-44.

121. Cha WC, Song KJ, Cho JS, Singer AJ, Shin SD. The long-term effect of an independent capacity protocol on emergency department length of stay: a before and after study. Yonsei Med J. 2015;56(5):1428-36.

122. Fulbrook P, Jessup M, Kinnear F. Implementation and evaluation of a 'Navigator' role to improve emergency department throughput. Australas Emerg Nurs J. 2017;20(3):114-21.

123. Han JH, France DJ, Levin SR, Jones ID, Storrow AB, Aronsky D. The effect of physician triage on emergency department length of stay. J Emerg Med. 2010;39(2):227-33.

124. Imperato J, Morris DS, Binder D, Fischer C, Patrick J, Dahomey Sanchez L, et al. Physician in triage improves emergency department patient throughput. Int Emerg Med. 2012;7:457-62.

125. Kim MJ, Park JM, Je SM, You JS, Park YS, Chung HS, et al. Effects of a short text message reminder system on emergency department length of stay. Int J Med Inform. 2012;81(5):296-302.

126. Lauks J, Mramor B, Baumgartl K, Maier H, Nickel CH, Bingisser R. Medical team evaluation: effect on emergency department waiting time and length of stay. PloS One. 2016;11(4).

127. Lee IH, Chen CT, Lee YT, Hsu YS, Lu CL, Huang HH, et al. A new strategy for emergency department crowding: high-turnover utility bed intervention. Journal of the Chinese Medical Association. 2017;80(5):297-302.

128. Lee-Lewandrowski E, Corboy D, Lewandrowski K, Sinclair J, McDermot S, Benzer TI. Implementation of a point-of-care satellite laboratory in the emergency department of an academic medical center. Arch Pathol Lab Med. 2003;127:456-60.

129. Lee-Lewandrowski E, Nichols J, Van Cott E, Grisson R, Louissaint A, Benzer T, et al. Implementation of a rapid whole blood D-dimer test in the emergency department of an urban academic medical center: impact on ED length of stay and ancillary test utilization. Am J Clin Pathol. 2009;132(3):326-31.

130. Mason S, Weber EJ, Coster J, Freeman J, Locker T. Time patients spend in the emergency department: England's 4-hour rule-a case of hitting the target but missing the point? Ann Emerg Med. 2012;59(5):341-9.

131. McGrath J, LeGare A, Hermanson L, Repplinger MD. The impact of a flexible care area on throughput measures in an academic emergency department. J Emerg Nurs. 2015;41:503-9.

132. McHugh M, Van Dyke K, Howell E, Adams F, Moss D, Yonek J. Changes in patient flow among five hospitals participating in a learning collaborative. Journal for Healthcare Quality. 2013;35(1):21-9.

133. Mumma BE, McCue JY, Li CS, Holmes JF. Effects of emergency department expansion on emergency department patient flow. Acad Emerg Med. 2014;21(5):504-9.

134. Nagree Y, Ercleve TNO, Sprivulis PC. After-hours general practice clinics are unlikely to reduce low acuity patient attendances to metropolitan Perth emergency departments. Aust Health Rev. 2004;28(3):285-91.

135. Ngo H, Forero R, Mountain D, Fatovich D, Man WN, Sprivulis P, et al. Impact of the four-hour rule in Western Australian hospitals: trend analysis of a large record linkage study 2002-2013. Plos One. 2018;13(3).

136. Partovi SN, Nelson BK, Bryan ED, Walsh MJ. Faculty triage shortens emergency department length of stay. Acad Emerg Med. 2001;8(10):990-5.

137. Patel PB, Combs MA, Vinson DR. Reduction of admit wait times: the effect of a leadership-based program. Acad Emerg Med. 2014;21:266-73.

138. Perera ML, Davies AW, Gnaneswaran N, Giles M, Liew D, Ritchie P, et al. Clearing emergency departments and clogging wards: National Emergency Access Target and the law of unintended consequences. Emerg Med Australas. 2014;26:549-55.

139. Sharma A, Inder B. Impact of co-located general practitioner (GP) clinics and patient choice on duration of wait in the emergency department. Emerg Med J. 2011;28:658-61.

140. Shin S, Lee SH, Kim DH, Kim SC, Kim TY, Kang C, et al. The impact of the improvement in internal medicine consultation process on ED length of stay. J Emerg Med. 2018;36(4):620-4.

141. Singer AJ, Viccellio P, Thode HC, Jr., Bock JL, Henry MC. Introduction of a stat laboratory reduces emergency department length of stay. Acad Emerg Med. 2008;15(4):324-8.

142. Takakuwa K, Shofer F, Abbuhl S. Strategies to deal with emergency department overcrowding: a one-year study on how bedside registration affects patient throughput times. J Emerg Med. 2007;32(4):337-42.

143. van der Linden C, Lucas C, van der Linden N, Lindeboom R. Evaluation of a flexible acute admission unit: effects on transfers to other hospitals and patient throughput times. J Emerg Nurs. 2013;39(4):340-5.

144. White BA, Brown DFM, Sinclair J, Chang Y, Carignan S, McIntyre J, et al. Supplemented triage and rapid treatment (START) improves performance measures in the emergency department. J Emerg Med. 2012;42(3):332-28.

145. Whittaker W, Anselmi L, Kristensen SR, Lau YS, Bailey S, Bower P, et al. Associations between extending access to primary care and emergency department visits: a difference-in-differences analysis. PLoS Med. 2016;13(9):e1002113.

146. Willard E, Carlton EF, Moffat L, Barth BE. A full-capacity protocol allows for increased emergency patient volume and hospital admissions. J Emerg Nurs. 2017;43(5):413-8.

147. Chiu IM, Lin YR, Syue YJ, Kung CT, Wu KH, Li CJ. The influence of crowding on clinical practice in the emergency department. Am J Emerg Med. 2018;36(1):56-60.

148. Diercks DB, Roe MT, Chen AY, Peacock WF, Kirk JD, Pollack J, Charles V., et al. Prolonged emergency department stays of non–ST-segment-elevation myocardial infarction patients are associated with worse adherence to the American College of Cardiology/American Heart Association guidelines for management and increased adverse events. Health Policy and Clinical Practice. 2007;50(5):489-96.

149. Fee C, Weber EJ, Maak CA, Bacchetti P. Effect of emergency department crowding on time to antibiotics in patients admitted with community-acquired pneumonia. Ann Emerg Med. 2007;50(5):501-9, 9 e1.

150. Gaieski DF, Agarwal AK, Mikkelsen ME, Drumheller B, Cham Sante S, Shofer FS, et al. The impact of ED crowding on early interventions and mortality in patients with severe sepsis. Am J Emerg Med. 2017;35(7):953-60.

151. Hwang U, Richardson LD, Sonuyi TO, Morrison RS. The effect of emergency department crowding on the management of pain in older adults with hip fracture. J Am Geriatr Soc. 2006;54(2):270-5.

152. Hwang U, Richardson L, Livote E, Harris B, Spencer N, Sean Morrison R. Emergency department crowding and decreased quality of pain care. Acad Emerg Med. 2008;15(12):1248-55.

153. Jo S, Jeong T, Jin YH, Lee JB, Yoon J, Park B. ED crowding is associated with inpatient mortality among critically ill patients admitted via the ED: post hoc analysis from a retrospective study. Am J Emerg Med. 2015;33:1725-31.

154. Kulstad EB, Kelley KM. Overcrowding is associated with delays in percutaneous coronary intervention for acute myocardial infarction. Int J Emerg Med. 2009;2(3):149-54.

155. Liew D, Liew D, Kennedy MP. Emergency department length of stay independently predicts excess inpatient length of stay. Med J Aust. 2003;179:524-6.

156. Liu SW, Chang Y, Weissman JS, Griffey RT, Thomas J, Nergui S, et al. An empirical assessment of boarding and quality of care: delays in care among chest pain, pneumonia, and cellulitis patients. Acad Emerg Med. 2011;18:1339-48.

157. McCarthy ML, Zeger SL, Ding R, Levin SR, Desmond JS, Lee J, et al. Crowding delays treatment and lengthens emergency department length of stay, even among high-acuity patients. Ann Emerg Med. 2009;54(4):492-503 e4.

158. McCusker J, Vadeboncoeur A, Levesque J-F, Ciampi A, Belzile E. Increases in emergency department occupancy are associated with adverse 30-day outcomes. Acad Emerg Med. 2014;21:1092-100.

159. Mills AM, Shofer FS, Chen EH, Hollander JE, Pines JM. The association between emergency department crowding and analgesia administration in acute abdominal pain patients. Acad Emerg Med. 2009;16:603-8.

160. Nippak PMD, Winston IW, Ikeda-Douglas CJ, Marion AM, VandenBorek M. Is there a relation between emergency department and inpatient lengths of stay? Can J Rural Med. 2014;19(1):12-20.

161. Pines JM, Hollander JE, Localio AR, Metlay JP. The association between emergency department crowding and hospital performance on antibiotic timing for pneumonia and percutaneous intervention for myocardial infarction. Acad Emerg Med. 2006;13(8):873-8.

162. Pines JM, Localio AR, Hollander JE, Baxt WG, Lee H, Phillips C, et al. The impact of emergency department crowding measures on time to antibiotics for patients with community-acquired pneumonia. Ann Emerg Med. 2007;50(5):510-6.

163. Pines JM, Pollack CV, Jr., Diercks DB, Chang AM, Shofer FS, Hollander JE. The association between emergency department crowding and adverse cardiovascular outcomes in patients with chest pain. Acad Emerg Med. 2009;16(7):617-25.

164. Pines JM, Shofer FS, Isserman JA, Abbuhl SB, Mills AM. The effect of emergency department crowding on analgesia in patients with back pain in two hospitals. Acad Emerg Med. 2010;17:276-83.

165. Reznek MA, Murray E, Youngren MN, Durham NT, Michael SS. Door-to-imaging time for acute stroke patients is adversely affected by emergency department crowding. Stroke. 2017;48(1):49-54.

166. Richardson DB. The access-block effect: relationship between delay to reaching an inpatient bed and inpatient length of stay. Med J Aust. 2002;177:492-5.

167. Richardson DB. Increase in patient mortality at 10 days associated with emergency department overcrowding. Med J Aust. 2006;184(5):213-6.

168. Richardson D, McMahon KL. Emergency department access block occupancy predicts delay to surgery in patients with fractured neck of femur. Emerg Med Australas. 2009;21(4):304-8.

169. Singer AJ, Thode HC, Jr., Viccellio P, Pines JM. The association between length of emergency department boarding and mortality. Acad Emerg Med. 2011;18(12):1324-9.

170. Spirvulis PC, Da Silva J-A, Jacobs IG, Frazer AR, Jelinek GA. The association between hospital overcrowding and mortality among patients admitted via Western Australian emergency departments. Med J Aust. 2006;184(5):208-12.

171. Tekwani KL, Kerem Y, Mistry CD, Sayger BM, Kulstad EB. Emergency department crowding is associated with reduced satisfaction scores in patients discharged from the emergency department. West J Emerg Med. 2013;14(1):11-5.

172. Tsai MT, Yen YL, Su CM, Hung CW, Kung CT, Wu KH, et al. The influence of emergency department crowding on the efficiency of care for acute stroke patients. Int J Qual Saf Healthcare. 2016;28(6):774-8.

173. van der Linden MC, Meester B, van der Linden N. Emergency department crowding affects triage processes. Int Emerg Nurs. 2016;29:27-31.

174. White BA, Biddinger PD, Chang Y, Grabowski B, Carignan S, Brown DFM. Boarding inpatients in the emergency department increases discharged patient length of stay. J Emerg Med. 2013;44(1):230-5.

175. Wickman L, Svensson P, Djarv T. Effect of crowding on length of stay for common chief complaints in the emergency department: a STROBE cohort study. Medicine. 2017;96(44).

176. Zhou J-C, Pan K-H, Zhou D-Y, Zheng S-W, Zhu J-Q, Xu Q-P, et al. High hospital occupancy is associated with increased risk for patients boarding in the emergency department. Am J Emerg Med. 2012;125:416.e1-.e7.

177. Aboagye-Sarfo P, Mai Q, Sanfilippo FM, Preen DB, Stewart LM, Fatovich DM. Growth in Western Australian emergency department demand during 2007-2013 is due to people with urgent and complex care needs. Emerg Med Australas. 2015;27(3):202-9.

178. Cowling TE, Cecil EV, Soljak MA, Lee JT, Millett C, Majeed A, et al. Access to primary care and visits to emergency departments in England: a cross-sectional, population-based study. PLoS One. 2013;8(6):e66699.

179. Dunn R. Reduced access block causes shorter emergency department waiting times: an historical control observational study. Emergency Medicine. 2003;15:232-8.

180. Fatovich DM, Nagree Y, Sprivulis P. Access block causes emergency department overcrowding and ambulance diversion in Perth, Western Australia. Emerg Med J. 2005;22(5):351-4.

181. Forster AJ, Stiell I, Wells G, Lee AJ, van Walraven C. The effect of hospital occupancy on emergency department length of stay and patient disposition. Acad Emerg Med. 2003;10(2):127-33.

182. Kawano T, Nishiyama K, Hayashi H. Adding more junior residents may worsen emergency department crowding. PLoS One. 2014;9(11):e110801.

183. Kawano T, Nishiyama K, Anan H, Tujimura Y. Direct relationship between aging and overcrowding in the ED, and a calculation formula for demand projection: a cross-sectional study. Emerg Med J. 2014;31(1):19-23.

184. Knapman M, Bonner A. Overcrowding in medium-volume emergency departments: effects of aged patients in emergency departments on wait times for non-emergent triage-level patients. Int J Nurs Pract. 2010;16(3):310-7.

185. Lucas R, Farley H, Twanmoh J, Urumov A, Olsen N, Evans B, et al. Emergency department patient flow: the influence of hospital census variables on emergency department length of stay. Acad Emerg Med. 2009;16:597-602.

186. Moineddin R, Meaney C, Agha M, Zagorski B, Glazier RH. Modeling factors influencing the demand for emergency department services in Ontario: a comparison of methods. BMC Emerg Med. 2011;11:13.

187. Sprivulis P. Estimation of the general practice workload of a metropolitan teaching hospital emergency department. Emergency Medicine. 2003;15:32-7.

188. Allen P, Cheek C, Foster S, Ruigrok M, Wilson D, Shires L. Low acuity and general practice-type presentations to emergency departments: a rural perspective. Emerg Med Australas. 2015;27(2):113-8.

189. Nagree Y, Camarda VJ, Fatovich DM, Cameron PA, Dey I, Gosbell AD, et al. Quantifying the proportion of general practice and low-acuity patients in the emergency department. Med J Aust. 2013;198(11):612-5.

190. Morris ZS, Boyle A, Beniuk K, Robinson S. Emergency department crowding: towards an agenda for evidence-based intervention. Emerg Med J. 2012;29(6):460-6.

191. Durand AC, Palazzolo S, Tanti-Hardouin N, Gerbeaux P, Sambuc R, Gentile S. Nonurgent patients in emergency departments: rational or irresponsible consumers? Perceptions of professionals and patients. BMC Res Notes. 2012;5:525.

192. Cameron PA. Hospital overcrowding: a threat to patient safety? Med J Aust. 2006;184(5):203-4.

193. Australian Institute of Health and Welfare. Australian Hospital Statistics 2013-2014: Emergency Department Care. Canberra: AIHW; 2014.

194. Patient experiences in Australia: Summary of Findings, 2013-14 [Internet]. 2014 [cited Janurary 16th 2016]. Available from: http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/4839.0~2013-14~Main%20Features~Hospital%20admissions%20and%20emergency%20departments~5.

195. 1270.0.55.001 - Australian Statistical Geography Standard (ASGS): Volume 1 - Main Structure and Greater Capital City Statistical Areas [Internet]. Australian Bureau of Statistics. 2010 [cited 21 November 2016]. Available from: http://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/88F6A0EDEB8879C0CA257801000C64D9.

196. Australasian College for Emergency Medicine. Policy on the Australian triage scale: Australasian College for Emergency Medicine; 1993 [updated July 2013; cited 21 November

2016]. Available from: https://www.acem.org.au/getattachment/693998d7-94be-4ca7-a0e7-3d74cc9b733f/Policy-on-the-Australasian-Triage-Scale.aspx.

197. Primary Health Tasmania. After Hours Care 2015 [cited 9th November 2015]. Available from: http://www.primaryhealthtas.com.au/programs-services/after-hours-care.

198. ERP by LGA (ASGS 2014), 2001 to 2014 [Internet]. 2015 [cited February 15th 2015]. Available from: http://stat.abs.gov.au/Index.aspx?QueryId=1268#.

199. Callen JL, Blundell L, Prgomet M. Emergency department use in a rural Australian setting: are the factors prompting attendance appropriate? Aust Health Rev. 2008;32(4):710-20.

200. Cheek C, Allen P, Shires L, Parry D, Ruigrok M. Low-acuity presentations to regional emergency departments: what is the issue? Emerg Med Australas. 2016;28(2):145-52.

201. Tasmanian Medicare Local. 2014 Census of Tasmanian General Practices. Hobart: Tasmanian Medicare Local Limited; 2015.

202. Dinh MM, Berendsen Russell S, Bein KJ, Chalkley DR, Muscatello D, Paoloni R, et al. Statewide retrospective study of low acuity emergency presentations in New South Wales, Australia: who, what, where and why? BMJ Open. 2016;6(5):e010964.

203. Unwin M, Kinsman L, Rigby S. Why are we waiting? Patients' perspectives for accessing emergency department services with non-urgent complaints. Int Emerg Nurs. 2016;29:3-8.

204. Patient experiences in Australia, 2013-14: Tasmania [Internet]. Commonwealth of Australia. 2015 [cited November 30th 2015]. Available from: http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4839.0.55.0022013-14?OpenDocument.

205. Shaw EK, Howard J, Clark EC, Etz RS, Arya R, Tallia AF. Decision-making processes of patients who use the emergency department for primary care needs. J Health Care Poor Underserved. 2013;24(3):1288-305.

206. Lowthian J, Curtis A, Stoelwinder J, McNeil J, Cameron P. Emergency demand and repeat attendances by older patients. Intern Med J. 2013;43(5):554-60.

207. Australian Bureau of Statistics. Socio-economic indexes for areas. Canberra: ABS; 2013 [updated September 23rd 2013 Available from: http://www.abs.gov.au/websitedbs/censushome.nsf/home/seifa

208. Australian Bureau of Statistics. SEIFA- using and interpreting SEIFA. Canberra: ABS; 2013 [updated September 19th 2013 Available from:

http://www.abs.gov.au/websitedbs/censushome.nsf/home/seifahelpansuis?opendocument&navpos=260&.

209. Polit DF, Tatano Beck C. Nursing research. Generating and assessing evidence for nursing practice. Ninth ed. New York: Lippincott, Williams and Wilkins; 2012.

210. Anthonisen NR. Retrospective studies. Can Respir J. 2009;16(4):117-8.

211. Sedgwick P. Retrospective cohort studies: advantages and disadvantages. BMJ [Internet]. 2014; 348.

212. Leonard C, Bein KJ, Latt M, Muscatello D, Veillard AS, Dinh MM. Demand for emergency department services in the elderly: an 11 year analysis of the Greater Sydney area. Emerg Med Australas. 2014;26(4):356-60.

213. Ionescu-Ittu R, McCusker J, Ciampi A, Vadeboncoeur AM, Roberge D, Larouche D, et al. Continuity of primary care and emergency department utilization among elderly people. CMAJ. 2007;177(11):1362-8.

214. Nyweide DJ, Bynum JPW. Relationship between continuity of ambulatory care and risk of emergency department episodes among older adults. Ann Emerg Med. 2017;69(4):407-15.

215. Lowthian JA, Smith C, Stoelwinder JU, Smit DV, McNeil JJ, Cameron PA. Why older patients of lower clinical urgency choose to attend the emergency department. Intern Med J. 2013;43(1):59-65.

216. Donabedian A. Models for organizing the delivery of personal health services and criteria for evaluating them. The Milbank Memorial Fund Quarterly. 1972;50(4):103-54.

217. World Health Organisation. Primary health care. International Conference on Primary Health Care, Alma-Ata, USSR, 6-12 September 1978; Geneva, Switzerland: WHO; 1978.

218. Aday LA, Andersen RM. Equity of access to medical care: a conceptual and empirical overview. Med Care. 1981;19(12):4-27.

219. Khan AA, Bhardwaj SM. Access to health care. Evaluation & the Health Professions. 1994;17(1):60-76.

220. Rogers A, Flowers J, Pencheon D. Improving access needs a whole systems approach. And will be important in averting crises in the millennium winter. BMJ. 1999;319(2):866-7.

221. Gulliford M, Figueroa-Munoz J, Morgan M, Hughes D, Gibson B, Beech R, et al. What does `access to health care' mean? Journal of Health Service Res Policy. 2002;7(3):186-8.

222. Haggerty JL, Beaulieu C, Lawson B, Santor DA, Fournier M, Burge F. What patients tell us about primary healthcare evaluation instruments: response formats, bad questions and missing pieces. Healthcare Policy. 2011;7(Spec issue):66-78.

223. Callander E, Larkins S, Corscadden L. Variations in out-of-pocket costs for primary care services across Australia: a regional analysis. Aust J Prim Health. 2017;23:379-85.

224. Andersen RM, Newman JF. Societal and individual determinants of medical care utilization in the United States. The Milbank Memorial Fund Quarterly. 1973;51(1):95-124.

225. Penchansky R, Thomas JW. The concept of access: definition and relationship to consumer satisfaction. Med Care. 1981;19(2):127-40.

226. Thomas JW, Penchansky R. Relating satisfaction with access to utilisation of services. Med Care. 1984;22(6):553-68.

227. Ward B, Humphreys J, McGrail M, Wakerman J, Chisholm M. Which dimensions of access are most important when rural residents decide to visit a general practitioner for non-emergency care? Aust Health Rev. 2015;39(2):121-6.

228. Levesque JF, Harris MF, Russell G. Patient-centred access to health care: conceptualising access at the interface of health systems and populations. Int J Equity Health. 2013;12:18.

229. Haggerty JL, Roberge D, Levesque JF, Gauthier J, Loignon C. An exploration of rural-urban differences in healthcare-seeking trajectories: implications for measures of accessibility. Health Place. 2014;28:92-8.

230. Billings J, Zeitel L, Lukomnik J, Carey TS, Blank AE, Newman L. Impact of socioeconomic status on hospital use in New York City. Health Aff (Millwood). 1993;12:162-73.

231. Greaves M, RogersClark C. The experience of socially isolated older people in accessing and navigating the health care system. Aust J Adv Nurs. 2009;27(2):5-11.

232. Fitzpatrick AL, Powe NR, Cooper LS, Ives DG, Robbins JA. Barriers to health care access among the elderly and who perceives them. Am J Public Health. 2004;94(10):1788-94.

233. Alston M, Allan J, Dietsch E, Wilkinson J, Shankar J, Osburn L, et al. Brutal neglect: Australian rural women's access to health services. Rural and Remote Health. 2006:1-19.

234. Hausdorf K, Rogers C, Whiteman D, Newman B, Coxeter P, Youl P, et al. Rating access to health care: are there differences according to geographical region? Aust N Z J Public Health. 2008;32(3):246-9.

235. Callander EJ, Corscadden L, Levesque JF. Out-of-pocket healthcare expenditure and chronic disease? Do Australians forgo care because of the cost? Aust J Prim Health. 2016.

236. Swerissen H, Duckett S, Wright J. Chronic failure in primary care. Victoria, Australia: Gratton Institute; 2016.

237. Australian Institute of Health and Welfare. Australia's Health 2016. Canberra: AIHW; 2016.

238. Australian Institute of Health and Welfare. Health expenditure Australia 2014–15 Canberra: AIHW; 2016 [updated August 11th 2017. Available from: https://www.aihw.gov.au/reports/health-welfare-expenditure/health-expenditure-australia-2014-15/contents/table-of-contents.

239. Australian Institute of Health and Welfare. Web update: Potentially preventable hospitalisations in 2015–16 Canberra: AIHW; 2017 [updated July 14th 2017. Available from: https://www.myhealthycommunities.gov.au/our-reports/potentially-preventable-hospitalisations-update/july-2017.

240. Tian Y, Dixon A, Gao H. Data briefing: emergency hospital admissions for ambulatory care sensitive conditions. London, UK: The King's Fund; 2012.

241. Katterl R, Anikeeva O, Butler C, Brown L, Smith B, P. B. Potentially avoidable hospitalisations in Australia: causes for hospitalisations and primary health care interventions. Adelaide: Primary Health Care Research & Information Service; 2012.

242. Falster M, Jorm L. A guide to the potentially preventable hospitalisations indicator in Australia. Sydney: Centre for Big Data Research in Health, University of New South Wales in consultation with Australian Commission on Safety and Quality in Health Care and Australian Institute of Health and Welfare; 2017.

243. Purdy S, Griffin T, Salisbury C, Sharp D. Ambulatory care sensitive conditions: terminology and disease coding need to be more specific to aid policy makers and clinicians. Public Health. 2009;123(2):169-73.

244. Bindman AB, Grumbach K, Osmond D, Komaromy M, Vranizan K, Lurie N, et al. Preventable hospitalizations and access to health care. JAMA. 1995;274(4):305-11.

245. Sanderson C, Dixon J. Conditions for which onset or hospital admission is potentially preventable by timely and effective ambulatory care. Journal of Health Service Res Policy. 2000;5(4):222-30.

246. Brown AD, Goldacre MJ, Hicks N, Rourke JT, McMurtrt RY, Brown JD, et al. Hospitalization for ambulatory care-sensitive conditions: a method for comparative access and quality studies using routinely collected statistics. Can J Public Health. 2001;92(2):155-9.

247. Ansari Z, Carson N, Serraglio A, Barbetti T, Cicuttini F. The Victorian ambulatory care sensitive conditions study: reducing demand on hospital services in Victoria. Aust Health Rev. 2002;25(2):71-7.

248. Caminal J, Starfield B, Sanchez E, Casanova C, Morales M. The role of primary care in preventing ambulatory care sensitive conditions. Eur J Public Health. 2004;14:246-51.

249. Ansari Z, Laditka JN, Laditka SB. Access to health care and hospitalization for ambulatory care sensitive conditions. Med Care Res Rev. 2006;63(6):719-41.

250. Ansari Z. The concept and usefulness of ambulatory care sensitive conditions as indicators of quality and access to primary health care. Aust J Prim Health. 2007;13(3):91-110.

251. Rosano A, Loha CA, Falvo R, van der Zee J, Ricciardi W, Guasticchi G, et al. The relationship between avoidable hospitalization and accessibility to primary care: a systematic review. Eur J Public Health. 2013;23(3):356-60.

252. Parchman ML, Culler SD. Preventable hospitalizations in primary care shortage areas. Arch Fam Med. 1999;8(6):487-91.

253. Laditka JN, Laditka SB, Probst JC. More may be better: evidence of a negative relationship between physician supply and hospitalization for ambulatory care sensitive conditions. Health Serv Res. 2005;40(4):1148-66.

254. Zhang W, Mueller KJ, Chen L-W, Conway K. The role of rural health clinics in hospitalization due to ambulatory care sensitive conditions: a study in Nebraska. J Rural Health. 2006;22(3):220-3.

255. Probst JC, Laditka JN, Laditka SB. Association between community health center and rural health clinic presence and county-level hospitalization rates for ambulatory care sensitive conditions: an analysis across eight US states. BMC Health Serv Res. 2009;9:134.

256. Falster MO, Jorm LR, Douglas KA, Blyth FM, Elliott RF, Leyland AH. Sociodemographic and health characteristics, rather than primary care supply, are major drivers of geographic variation in preventable hospitalizations in Australia. Med Care. 2015;53(5):436-45.

257. Milne BJ, Parker K, McLay J, von Randow M, Lay-Yee R, Hider P, et al. Primary health care access and ambulatory sensitive hospitalizations in New Zealand. The Journal of Ambulatory Care Management. 2015;38(2):178-87.

258. Ricketts TC, Randolph R, Howard HA, Pathman D, Carey T. Hospitalization rates as indicators of access to primary care. Health & Place. 2001:27-38.

259. Purdy S, Griffin T, Salisbury C, Sharp D. Prioritizing ambulatory care sensitive hospital admissions in England for research and intervention: a Delphi exercise. Prim Health Care Res Dev. 2010;11(01):41-50.

260. Barker I, Steventon A, Deeny SR. Association between continuity of care in general practice and hospital admissions for ambulatory care sensitive conditions: cross sectional study of routinely collected, person level data. BMJ. 2016;356(J84).

261. Deeny S, Gardner T, Al-Zaidy S, Barker I, Steventon A. Briefing: Reducing hospital admissions by improving continuity of care in general practice. London: The Health Foundation; 2017.

262. Dusheiko M, Doran T, Gravelle H, Fullwood C, Roland M. Does higher quality of diabetes management in family practice reduce unplanned hospital admissions? Health Serv Res. 2011;46(1 Pt 1):27-46.

263. Takeda A, Taylor SJ, Taylor RS, Khan F, Krum H, Underwood M. Clinical service organisation for heart failure (Review). Cochrane Database Syst Rev. 2012(9):CD002752.

264. Kruis AL, Smidt N, Assendelft WJ, Gussekloo J, Boland MR, Rutten-van Molken M, et al. Integrated disease management interventions for patients with chronic obstructive pulmonary disease (Review). Cochrane Database Syst Rev. 2013;10:CD009437.

265. Hayes SL, McCarthy D. Care management plus: strengthening primary care for patients with multiple chronic conditions. The Commonwealth Fund; 2016.

266. Lee GA, Titchener K. The Guy's and St Thomas's NHS Foundation Trust @home service: an overview of a new service. London J Prim Care (Abingdon). 2017;9(2):18-22.

267. McNab J, Gillespie JA. Bridging the chronic care gap: HealthOne Mt Druitt, Australia. International Journal of Integrated Care. 2015;15(23):1-14.

268. Duckett S, Moran G, Danks L. Making health care more affordable and effective for both taxpayers and patients: Grattan Institute submission to the Senate Community Affairs References Committee inquiry into the value and affordability of private health insurance and out-of-pocket medical costs. Melbourne, Australia: Grattan Institute; 2017.

269. Burkett E, Martin-Khan MG, Scott J, Samanta M, Gray LC. Trends and predicted trends in presentations of older people to Australian emergency departments: effects of demand growth, population aging and climate change. Aust Health Rev. 2017.

270. Khan AA, Bhardwaj SM. Access to health care. A conceptual framework and its relevance to health care planning. Eval Health Prof. 1994;17(1):60-76.

271. Australian Institute of Health and Welfare. Admitted patient care 2013–14. Australian hospital statistics. Canberra: AIHW; 2015.

272. ICD-10 Version: 2016 [Internet]. 2016 [cited June 2017]. Available from: http://apps.who.int/classifications/icd10/browse/2016/en.

273. Australian Institute of Health and Welfare. National Healthcare Agreement: PI 18-Selected potentially preventable hospitalisations, 2014 Canberra2014 [Sept 2016]. Available from: http://meteor.aihw.gov.au/content/index.phtml/itemId/517648.

274. Australian Bureau of Statistics. 3235.0 - Population by Age and Sex, Regions of Australia, 2016 Canberra, Australia: ABS; 2017 [22 November 2017]. Available from: http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3235.02016?OpenDocument.

275. Australian Bureau of Statistics. 4102.0 - Australian Social Trends, June 2009 Canberra: ABS; 2009 [cited 2018 January 24th]. Available from: http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4102.0Main+Features20June+2009.

276. Balakrishnan MP, Herndon JB, Zhang J, Payton T, Shuster J, Carden DL. The association of health literacy with preventable emergency department visits: a cross-sectional study. Acad Emerg Med. 2017;24(9):1042-50.

277. Reed R, Isherwood L, Ben-Tovim D. Why do older people with multi-morbidity experience unplanned hospital admissions from the community: a root cause analysis. BMC Health Serv Res. 2015;15(525).

278. Department of Health and Human Services. Bridging the communication gap. Communication and Health Literacy Action Plan 1 July 2015 – 30 June 2017. Public Health Services. Tasmanian Government; 2015.

279. Commonwealth of Australia. Health-care homes. Canberra: Department of Health; 2018 [cited 2018 January 24th]. Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/health-care-homes-professional.

280. Yoon J, Cordasco KM, Chow A, Rubenstein LV. The relationship between same-day access and continuity in primary care and emergency department visits. PLoS One. 2015;10(9):e0135274.

281. Cecil E, Bottle A, Sharland M, Saxena S. Impact of UK primary care policy reforms on short-stay unplanned hospital admissions for children with primary care–sensitive conditions. Ann Fam Med. 2015;13:214-20.

282. Primary Health Care Advisory Group. Better outcomes for people with chronic and complex health conditions through primary health care: Discussion paper. 2015.

283. Glasby J, Littlechild R, Le Mesurier N, Thwaites R, Oliver D, Jones S, et al. Who knows best? Older people's contribution to understanding and preventing avoidable hospital admissions. Birmingham, UK: University of Birmingham; 2016.

284. Morley C, Unwin M, Peterson GM, Stankovich J, Kinsman L. Emergency department crowding: a systematic review of causes, consequences and solutions. Plos One. 2018;13(8).

285. World Health Organisation. Global action plan for the prevention and control of noncommunicable diseases 2013-2020. Geneva: WHO; 2013.

286. Australian Health Ministers' Advisory Council (COAG). National strategic framework for chronic conditions. Canberra: Australian Government; 2017.

287. Australian Institute of Health and Welfare. The second Australian atlas of healthcare variation. Sydney: Australian Commission on Safety and Quality in Health Care; 2017.

288. Commonwealth of Australia. Cardiovascular Disease. Canberra: The Department of Health; 2016 [updated 28 November 2016; cited 2018 May 4th]. Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/chronic-cardio#wha.

289. Nichols M, Peterson KE, Herbert J, Alison L, Allender S. Australian heart disease statistics 2015. Melbourne: National Heart Foundation of Australia; 2016.

290. Australian Bureau of Statistics. 3222.0 - Population Projections, Australia, 2012 (base) to 2101 Canberra: ABS; 2013 [updated 26 November 2013. Available from: http://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/3222.0Main%20Features52012%20(base)%20to%202101?opendocument&tabname=Summary&prodno=3222.0&issue=2012%20(base)%20to%202101&num=&view=.

291. National Heart Foundation of Australia and the Cardiac Society of Australia and New Zealand. Guidelines for the prevention, detection and management of chronic heart failure in Australia, Updated October 2011. 2011.

292. National Heart Foundation of Australia. A systematic approach to chronic heart failure care: a consensus statement. Melbourne: National Heart Foundation of Australia; 2013.

293. Brake R, Jones ID. Chronic heart failure part 1: pathophysiology, signs and symptoms. Nurs Stand. 2017;31(19):54-63.

294. Mosterd A, Hoes AW. Clinical epidemiology of heart failure. Heart. 2007;93(9):1137-46.

295. Metra M, Teerlink JR. Heart failure. The Lancet. 2017;390(10106):1981-95.

296. Australian Institute of Health and Welfare. Heart failure...what of the future? Canberra: AIHW; 2003.

297. Chen L, Booley S, Keates AK, Stewart S. Snapshot of heart failure in Australia. Melbourne, Victoria: Mary MacKillop Institute for Health Research, Australian Catholic University; 2017.

298. Nicholson C. Chronic heart failure: pathophysiology, diagnosis and treatment. Nursing Older People. 2014;26(7):29-38.

299. Goodlin SJ. Palliative care in congestive heart failure. J Am Coll Cardiol. 2009;54(5):386-96.

300. Brake R, Jones ID. Chronic heart failure part 2: treatment and management. Nurs Stand. 2017;31(20):53-63.

301. Krum H, Driscoll A. Management of heart failure. Med J Aust. 2013;199(5):334-9.

302. Morley C, Peterson G, Stankovich J, Kinsman L. Patient-perceived access to care is a driver of increased emergency department presentations by the elderly. In: Moxham L, editor. 6th Annual International Conference on Worldwide Nursing July 23-24th 2018; Singapore: Global Science & Technology Forum; 2018. p. 50-8.

303. Gregory KE, Radovinsky L. Research strategies that result in optimal data collection from the patient medical record. Applied Nursing Research. 2012;25:108-16.

304. Gilbert EH, Lowenstein SR, KozioI-McLain J, Barta DC, Steiner J. Chart reviews in emergency medicine research: where are the methods? Ann Emerg Med. 1996;27:305-8.

305. Lowthian JA, Stoelwinder JU, McNeil JJ, Cameron PA. Is the increase in emergency short-stay admissions sustainable? Trends across Melbourne, 2000 to 2009. Emerg Med Australas. 2012;24(6):610-6.

306. Blunt I, Bardsley M, Dixon J. Trends in emergency admissions in England: 2004-2009. London: Ther Nuffield Trust; 2010.

307. Bueno H, Ross JS, Wang Y, Chen J, Vidan MT, Normand S-LT, et al. Trends in length of stay and short-term outcomes among Medicare patients hospitalized for heart failure, 1993-2006. JAMA. 2010;303(21):2141-7.

308. Baker DW, Einstadter D, Husak SS, Cebul RD. Trends in postdischarge mortality and readmissions. Has length of stay declined too far? Arch Intern Med. 2004;164:538-44.

309. Kaboli PJ, Go JT, Hockenberry J, Glasgow JM, Johnson SR, Rosenthal GE, et al. Associations between reduced hospital length of stay and 30-day readmission rate and mortality: 14-year experience in 129 Veterans Affairs hospitals. Ann Intern Med. 2012;157(12):837-45.

310. McAlister FA, Bakal JA, Majumdar SR, Dean S, Padwal RS, Kassam N, et al. Safely and effectively reducing inpatient length of stay: a controlled study of the General Internal Medicine Care Transformation Initiative. BMJ Qual Saf. 2014;23(6):446-56.

311. Peterson G. Risks of hospitalisation in elderly patients. Geriaction. 2008;26(2):30-3.

312. Inouye SK, Bogardus ST, Baker DI, Leo-Summers L, Cooney LM. The hospital elder life program: a model of care to prevent cognitive decline and functional decline in older hospitalized patients. J Am Geriatr Soc. 2000;48:1697-706.

313. Aminzadeh F, Dalziel WB. Older adults in the emergency department: a systematic review of patterns of use, adverse outcomes, and effectiveness of interventions. Annals of Emergency Medicine. 2002;39(3):238-47.

314. Walsh B. Unplanned admissions and readmissions in older people: a review of recent evidence on identifying and managing high-risk individuals. Reviews in Clinical Gerontology. 2014;24(03):228-37.

315. Henderson C, Sheaff R, Dickinson A, Beech R, Wistow G, Windle K, et al. Unplanned admissions of older people: the impact of governance. NIHR. Service Delivery and Organisation programme; 2011.

316. Or Z, Penneau A. A multilevel analysis of the determinants of emergency care visits by the elderly in France. Health Policy. 2018;122:908-14.

317. Department of Health and Human Services. Your health progress chart June 2015. Hobart: DHHS; 2015.

318. Guest G, Bunce A, Johnson L. How many interviews are enough? Field Methods. 2016;18(1):59-82.

319. Francis JJ, Johnston M, Robertson C, Glidewell L, Entwistle V, Eccles MP, et al. What is an adequate sample size? Operationalising data saturation for theory-based interview studies. Psychol Health. 2010;25(10):1229-45.

320. Burmeister E, Aitken LM. Sample size: how many is enough? Aust Crit Care. 2012;25(4):271-4.

321. Fusch PI, Ness LR. Are we there yet? Data saturation in qualitative research. The Qualitative Report. 2015;20(9):1408-16.

322. Mason M. Sample size and saturation in PhD studies using qualitative interviews. Forum: Qualitative Social Research. 2010;11(3):Atricle 8.

323. Baker SE, Edwards R. How many qualitative interviews is enough? Expert voices and early career reflections on sampling and cases in qualitative research. National Centre for Research Methods; 2012.

324. Malterud K, Siersma VD, Guassors D. Sample size in qualitative interview studies: guided by information power. Qual Health Res. 2016;26(13):1753-60.

325. Varpio L, Ajjawi R, Monrouxe LV, O'Brien BC, Rees CE. Shedding the cobra effect: problematising thematic emergence, triangulation, saturation and member checking. Med Educ. 2017;51(1):40-50.

326. Smith JA, Flowers P, Larkin M. Interpretative phenomenological analysis. London: Sage Publications Ltd; 2009.

327. Roller MR, Lavrakas PJ. Applied qualitative research design : a total quality framework approach. New York: Guilford Publications; 2015.

328. Ritchie J, Lewis J, editors. Qualititive research practice: a guide for social science researchers and students. London: Sage Publications; 2003.

329. Smith J, Firth J. Qualitative data analysis: the framework approach. Nurse Researcher. 2011;18(2):52-62.

330. Gale NK, Heath G, Cameron E, Rashid S, Redwood S. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. BMC Med Res Methodol. 2013;13(1):117.

331. Pope C, Ziebland S, Mays N. Qualitative research in health care. Analysing qualitative data. BMJ. 2000;320:114-6.

332. Braun V, Clarke V. Using thematic analysis in psychology. Qualitative Research in Psychology. 2006;3(2):77-101.

333. Furber C. Framework analysis: a method for analysing qualitative data. Africian Journal of Midwifery and Women's Health. 2010;4(2):97-100.

334. Hsiu-Fang H, Shannon SE. Three approaches to qualitative content analysis. Qual Health Res. 2005;15(9):1277-88.

335. Ontario Medical Association. Patient-centred care. Ontario Medical Review. 2010; Policy Paper(June 2010).

336. Huntley A, Lasserson D, Wye L, Morris R, Checkland K, England H, et al. Which features of primary care affect unscheduled secondary care use? A systematic review. BMJ Open. 2014;4(5):e004746.

337. van Loenen T, van den Berg MJ, Westert GP, Faber MJ. Organizational aspects of primary care related to avoidable hospitalization: a systematic review. Fam Pract. 2014;31(5):502-16.

338. Busby J, Purdy S, Hollingworth W. How do population, general practice and hospital factors influence ambulatory care sensitive admissions: a cross sectional study. BMC Fam Pract. 2017;18(1):67.

339. Kohnke H, Zielinski A. Association between continuity of care in Swedish primary care and emergency services utilisation: a population-based cross-sectional study. Scandinavian Journal of Primary Health Care. 2017;35(2):113-9.

340. Temple JB, Williams R. Multiple health conditions and barriers to healthcare among older Australians: prevalence, reasons and types of barriers. Aust J Prim Health. 2017;24(1):82-9.

341. Scott I, Jackson C. Chronic heart failure management in Australia. Time for general practice centred models of care? Australian Family Physician. 2013;42(5):343-6.

342. Kumpunen S, Rosen R, Kossarova L, Sherlaw-Johnson C. Primary care home: evaluating a new model of primary care. London: Nuffield Trust; 2017.

343. Sinaiko AD, Landrum MB, Meyers DJ, Alidina S, Meang DD, Friedberg MW, et al. Synthesis of research on patient-centered medical homes brings systematic differences into relief. Health Aff (Millwood). 2017;36(3):500-8.

344. Thurecht L, Woolcock K, Silk K, Partel K, Verhoeven A. Health Care Homes: principles and enablers for their implementation in Australia. ACT, Australia: Deeble Institute; 2017.

345. Longman JM, Rix E, Johnston JJ, Passey ME. Ambulatory care sensitive chronic conditions: what can we learn from patients about the role of primary health care in preventing admissions? Aust J Prim Health. 2018.

346. Barker I, Steventon A, Williamson R, Deeny SR. Self-management capability in patients with long-term conditions is associated with reduced healthcare utilisation across a whole health economy: cross-sectional analysis of electronic health records. BMJ Qual Saf. 2018.

347. Vitry AI, Nguyen TA, Ramsay EN, Caughey GE, Gilbert AL, Shakib S, et al. General practitioner management plans delaying time to next potentially preventable hospitalisation for patients with heart failure. Intern Med J. 2014;44(11):1117-23.

348. Leppin AL, Gionfriddo MR, Kessler M, Brito JP, Mair FS, Gallacher K, et al. Preventing 30-day hospital readmissions: a systematic review and meta-analysis of randomized trials. JAMA Intern Med. 2014;174(7):1095-107.

349. Infante FA, Proudfoot JG, Powell Davies G, Bubner TK, Holton CH, Beilby JJ, et al. How people with chronic illnesses view their care in general practice: a qualitative study. Med J Aust. 2004;181(2):70-3.

350. Hayenes Sanstad K, Maguire R. The capacity to care. Measuring perceptions of accessability and integration of healthcare systems, and adoption of connected healthcare. California, USA: Future Health Index; 2016.

351. de Silva D. Helping people help themselves. A review of the evidence considering whether it is worthwhile to support self-management. London: The Evidence Centre; 2011.

352. Sorensen K, Van den Broucke S, Fullam J, Doyle G, Pelikan J, Slonska Z, et al. Health literacy and public health: a systematic review and integration of definitions and models. BMC Public Health. 2012;12:80.

353. Evangelista EJ, James J, Deveny E. Implementing Anticipatory Care Plans in general practice: a practice approach to improving the health literacy of the community and reducing reliance on emergency services during after-hour periods. Aust J Prim Health. 2015.

354. Williams MV, Baker DW, Parker RM, Nurss JR. Relationahip of functional health literacy to patients' knowledge of their chronic condition. Arch Intern Med. 1998;158:166-72.

355. Harris M, Kidd M, Snowdon T. New models of primary and community care to meet the challenges of chronic disease prevention and management: a discussion paper for NHHRC. 2008.

356. White D, Hind D. Projection of participant recruitment to primary care research: a qualitative study. Trials. 2015;16:473.

357. Thomas R, Huntley A, Mann M, Huws D, Paranjothy S, Elwyn G, et al. Specialist clinics for reducing emergency admissions in patients with heart failure: a systematic review and meta-analysis of randomised controlled trials. Heart. 2013;99(4):233-9.

358. Krum H, Forbes A, Yallop J, Driscoll A, Croucher J, Chan B, et al. Telephone support to rural and remote patients with heart failure: the Chronic Heart Failure Assessment by Telephone (CHAT) study. Cardiovasc Ther. 2013;31(4):230-7.

359. Qaddoura A, Yazdan-Ashoori P, Kabali C, Thabane L, Haynes RB, Connolly SJ, et al. Efficacy of hospital at home in patients with heart failure: a systematic review and meta-analysis. PLoS One. 2015;10(6):e0129282.

360. Giordano A, Scalvini S, Zanelli E, Corrà U, G.L L, Ricci VA, et al. Multicenter randomised trial on home-based telemanagement to prevent hospital readmission of patients with chronic heart failure. International Journal of Cardiology. 2009;131(2):192-9.

361. Jovicic A, Holroyd-Leduc JM, Straus SE. Effects of self-management intervention on health outcomes of patients with heart failure: a systematic review of randomized controlled trials. BMC Cardiovasc Disord. 2006;6:43.

362. Ahn S, Basu R, Lee Smith M, HJiang L, Lorig K, Whitelaw N, et al. The impact of chronic disease self-management programs: healthcare savings through a community-based intervention. BMC Public Health. 2013;13(1141).

363. Howcroft M, Walters EH, Wood-Baker R, Walters JA. Action plans with brief patient education for exacerbations in chronic obstructive pulmonary disease. Cochrane Database Syst Rev. 2016;12:CD005074.

364. Mallitt KA, McNab J, Hughes R, Fernyhough J, Paterson J, O'Halloran D. Reducing emergency department presentations among chronically ill patients in Western Sydney: a key role for coordinated primary care. Aust J Prim Health. 2017;23:140-6.

365. Damery S, Flanagan S, Combes G. Does integrated care reduce hospital activity for patients with chronic diseases? An umbrella review of systematic reviews. BMJ Open. 2016;6(11):e011952.

366. Walsh M. CEO perspective: a health system for patients with complex conditions: reflections from Bridgepoint's transformation. Healthcare Quarterly. 2016;19(2):86-90.

367. Harris MF, Zwar NA. Care of patients with chronic disease: the challenge for general practice. Med J Aust. 2007;187:104-7.

368. Oldroyd J, Proudfoot J, Infante FA, Powell Davies G, Bubner T, Holton C, et al. Providing healthcare for people with chronic illness: the views of Australian GPs. Med J Aust. 2003;179(30-33).

369. Conley J, O'Brien CW, Leff BA, Bolen S, Zulman D. Alternative strategies to inpatient hospitalization for acute medical conditions: a systematic review. JAMA Intern Med. 2016;176(11):1693-702.

370. Hendry A, Taylor A, Mercer S, Knight P. Improving outcomes through transformational health and social care integration - the Scottish experience. Healthcare Quarterly. 2016;19(2):73-9.

371. Gullery C, Hamilton G. Towards integrated person-centred healthcare - the Canterbury journey. Future Hospital Journal. 2015;2(2):111-6.

372. Timmins N, Ham C. The quest for integrated health and social care. A case study in Canterbury, New Zealand. Canterbury, NZ: The King's Fund; 2013.

373. Canterbury Clinical Network. The Canterbury story 2018 [Available from: http://ccn.health.nz/OurHealthSystem/TheCanterburyStory.aspx.

374. McGeoch G, Anderson I, Gibson J, Gullery C, Kerr D, Shand B. Consensus pathways: evidence into practice. NZMJ. 2015;128(1408):86-96.

375. Epton M, Limber C, Gullery C, McGeoch G, Shand B, Laing R, et al. Reducing hospital admissions for COPD: perspectives following the Christchurch earthquake. BMJ Open Respir Res. 2018;5(1):e000286.

376. Lyons R, Kuluski K. The Bridgepoint Study: understanding complex patients and their health care needs. Ontario, Canada: Bridgepoint Collaborative for Research and Innovation; 2011.

377. Marwick T. Hospital admission and readmission for chronic cardiovascular disease: an avoidable cost for our health service. 2018 Arthur Cobbold Memorial Lecture; 2018; University of Tasmania.

378. The Scottish Government. Improving the health and wellbeing of people with long term conditions in Scotland: a national action plan. Edinburgh: The Scottsh Government; 2009 [updated Jun 10th 2009; cited 2018 September 26th]. Available from: https://www.gov.scot/Publications/2009/12/03112054/1.

379. The Scottish Government. Reshaping care for older people. A programme for change: 2011-2021. Edinburgh: The Scottish Government; 2011.

380. The Scottish Government. Reshaping care for older people. Edinburgh: The Scottsh Government; 2013 [cited 2018 September 26th]. Available from: https://www.gov.scot/Publications/2013/09/6983/1.

381. Health Care Homes hailed as life-saving by RACGP [press release]. East Melbourne: RACGP. , March 31st 2016.

382. Government fails to deliver on Health Care Homes [press release]. East Melbourne: RACGP., November 6th 2016.

383. Rollins A. Penny pinching threatens chronic care reform. Australian Medicine [Internet]. 2016. Available from: https://ama.com.au/ausmed/penny-pinching-threatens-chronic-care-reform.

384. Hoffman T. Practices need $100k extra to make Health Care Homes work: RACGP. Australian Doctor [Internet]. 2016. Available from: https://www.australiandoctor.com.au/news/practices-need-100k-extra-make-health-care-homes-work-racgp.

385. Smith P. What you need to know about the biggest GP reform in a generation. Australian Doctor [Internet]. 2016. Available from: https://www.australiandoctor.com.au/news/what-you-need-know-about-biggest-gp-reform-generation.

386. Smith P. Call for Govt to delay Health Care Homes rollout. Australian Doctor [Internet]. 2016. Available from: https://www.australiandoctor.com.au/news/call-govt-delay-health-care-homes-rollout.

387. Royal Australian College of General Practitioners. 2017-18 pre-budget submission. East Melbourne: Vic: RACGP; 2016.

388. O'Rourke G. Corporates dominate Health Care Homes trial. Australian Doctor [Internet]. 2017. Available from: https://www.australiandoctor.com.au/news/corporates-dominate-health-care-homes-trial.

389. O'Rourke G. Practices fear Health Care Homes payroll tax. Australian Doctor [Internet]. 2017. Available from: https://www.australiandoctor.com.au/news/practices-fear-health-care-homes-payroll-tax.

390. O'Rourke G. Health Care Homes on shaky ground as practices bail out. Australian Doctor [Internet]. 2017. Available from: https://www.australiandoctor.com.au/news/health-care-homes-shaky-ground-practices-bail-out.

391. Smith P, O'Rourke G. Health Care Homes roll out 'went wrong somewhere' says reform architect. Australian Doctor [Internet]. 2018. Available from: https://www.australiandoctor.com.au/news/health-care-homes-roll-out-went-wrong-somewhere-says-reform-architect.

392. Scholefield A. Rumours on Health Care Homes are true, health department confirms. Australian Doctor [Internet]. 2018. Available from: https://www.australiandoctor.com.au/news/rumours-health-care-homes-are-true-health-department-confirms.

393. Health Policy Analysis. Evaluation of the Health Care Homes program - Evaluation plan. Canberra: Department of Health; 2017.

394. O'Rourke G, Smith P. Greg Hunt's vision for Health Care Homes 2.0: fewer patients for longer. . Australian Doctor [Internet]. 2018. Available from: https://www.australiandoctor.com.au/news/greg-hunts-vision-health-care-homes-20-fewer-patients-longer.

395. Primary Health Tasmania. Tasmanian HealthPathways Hobart: PHT; 2018 [Available from: https://www.primaryhealthtas.com.au/for-health-professionals/tasmanian-healthpathways/.

396. Peiris D, Wells L, Javckson C. Snakes and ladders: the journey to primary care integration. The George Institute and Consumers Health Forum of Australia and The University of Queensland; 2018.

397. Jackson CL, Hambleton SJ. Australia's Health Care Homes: laying the right foundations. Med J Aust. 2017;206(9):380-1.

398. Menzies Centre for Health Policy. Patient centred healthcare homes in Australia: towards successful implementation. 2016.

399. Dunleavy S. The health care revolution that will see Aussies enrol with a GP for all their medical needs — but not everyone is happy about it. newscomau [Internet]. 2016 September 22nd 2018. Available from: https://www.news.com.au/lifestyle/health/the-health-care-revolution-that-will-see-aussies-enrol-with-a-gp-for-all-their-medical-needs--but-not-everyone-is-happy-about-it/news-story/a242b48df756bbbf405626500bf87618.

400. Australian Government. Health care homes. Handbook for general practices and aboriginal community controlled health services. In: Department of Health, editor. Canberra: Commonwealth of Australia; 2017.

401. Vassar E. A room with a view: the emergency department in the health care crisis. J Emerg Nurs. 1992;18(5):368-9.

402. Unwin M, Crisp E, Rigby S, Kinsman L. Investigating the referral of patients with non-urgent conditions to a regional Australian emergency department: a study protocol. BMC Health Serv Res. 2018;18(1):647.

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PLOS ONE

RESEARCH ARTICLE

Emergency department crowding: A systematic review of causes, consequences and solutions

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Abstract

Background

Emergency department crowding is a major global healthcare issue. There is much debate as to the causes of the phenomenon, leading to difficulties in developing successful, targeted solutions.

Aim

The aim of this systematic review was to critically analyse and summarise the findings of peer-reviewed research studies investigating the causes and consequences of, and solutions to, emergency department crowding.

Method

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed. A structured search of four databases (Medline, CINAHL, EMBASE and Web of Science) was undertaken to identify peer-reviewed research publications aimed at investigating the causes or consequences of, or solutions to, emergency department crowding, published between January 2000 and June 2018. Two reviewers used validated critical appraisal tools to independently assess the quality of the studies. The study protocol was registered with the International prospective register of systematic reviews (PROSPERO 2017: CRD42017073439).

Results

From 4,131 identified studies and 162 full text reviews, 102 studies met the inclusion criteria. The majority were retrospective cohort studies, with the greatest proportion (51%) trialling or modelling potential solutions to emergency department crowding. Fourteen studies examined causes and 40 investigated consequences. Two studies looked at both causes and consequences, and two investigated causes and solutions.

Conclusions

The negative consequences of ED crowding are well established, including poorer patient outcomes and the inability of staff to adhere to guideline-recommended treatment. This review identified a mismatch between causes and solutions. The majority of identified causes related to the number and type of people attending ED and timely discharge from ED, while reported solutions focused on efficient patient flow within the ED. Solutions aimed at the introduction of whole-of-system initiatives to meet timed patient disposition targets, as well as extended hours of primary care, demonstrated promising outcomes. While the review identified increased presentations by the elderly with complex and chronic conditions as an emerging and widespread driver of crowding, more research is required to isolate the precise local factors leading to ED crowding, with system-wide solutions tailored to address identified causes.

Introduction

Emergency Department (ED) crowding has been described as both a patient safety issue and a worldwide public health problem [1]. While many countries, including Ireland [2], Canada [3], and Australia [4], report significant and unsustainable increases in ED presentations, a growing number of studies have found that these increases cannot be explained by population growth alone [4–6]. Crowding in the ED can occur due to the volume of patients waiting to be seen (input), delays in assessing or treating patients already in the ED (throughput), or impediments to patients leaving the ED once their treatment has been completed (output) [7]. Consequently, there are likely to be many different causes of crowding, depending on when and where in the patient journey the crowding occurs. Therefore, if the international crisis [8] of ED crowding is to be solved, it is crucial that interventions designed to resolve the problem are tailored to address identified causes.

Recognising that crowding had become a major barrier to patients receiving timely ED care, Asplin and colleagues [7], in 2003, issued a 'call to arms' to researchers and policy makers to focus their efforts on alleviating the problem. Many answered the call, and there now exists considerable published research addressing the ED crowding agenda. Despite this, and perhaps due to the relative lack of published studies investigating the causes of crowding, many myths seem to persist as to the drivers of the problem [9, 10], thereby making the implementation of successful, sustainable solutions difficult. A systematic and critical review of the available evidence can aid researchers, clinicians and managers to make decisions regarding the best course of action [11].

The most recent comprehensive synthesis of the literature, that we identified, investigating the causes, effects and solutions to ED crowding, was undertaken ten years ago (2008) [8]. With the fast changing pace of research in the emergency medicine arena, it was anticipated that in the intervening years there would have been many developments as regards identifying both causes and consequences of ED crowding, as well as the implementation of successful solutions. The aim of this review was to expand on and provide an updated critical analysis of the findings of peer-reviewed research studies exploring the causes or consequences of, or solutions to, ED crowding.

Method

Definition of crowding

There is currently no consensus on the correct tool or unit of measurement to define ED crowding [12], with one systematic review identifying 71 unique measures currently in use

[13]. We therefore elected to include papers that had used any of the most commonly accepted metrics. These included: ED length of stay (EDLOS), rates of 'left without being seen' (LWBS) or did not wait (DNW), hours of ambulance bypass/diversion, hours of access block/boarding hours, proportion of presentations meeting nationally mandated, timed patient disposition targets (e.g. the Australian National Emergency Access Target (NEAT), the UK 4-hour target or the NZ Shorter-stays-in-emergency-departments target), Emergency Department Work Index (EDWIN) score, National Emergency Department Overcrowding Scale (NEDOCS) and ED census. Some studies used more than one of these measures as the dependent variable.

Search strategy

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed (S1 Table) [11]. A search was performed on four electronic databases: Medline, CINAHL, EMBASE and Web of Science. Search terms used were: 'emergency department', 'accident and emergency', 'ED', 'emergency service' "AND" 'crowding', 'overcrowding', 'utilisation', 'congestion' "AND" "OR" 'consequences', 'outcomes', 'harm', 'negative impact', 'mortality', 'causes' 'strategies', 'solutions', 'interventions'. All research published in the English language between January 2000 and June 2018 was eligible for inclusion. There was no restriction on types of studies, with quantitative, qualitative and mixed-methods studies all eligible for inclusion. Studies had to satisfy the following inclusion criteria to be considered: full text original research articles, published in peer-reviewed journals, investigating the causes and/or consequences of, and/or solutions to, crowding in general EDs. As research suggests that crowding may have different effects in paediatric populations compared to adults [14], studies undertaken in paediatric EDs were excluded. Full details of the search strategy are available in supplementary material (S1 File).

Study selection, assessment and data extraction

One reviewer (CM) reviewed the titles and abstracts to identify relevant articles. Two reviewers (CM and MU) independently reviewed the full text articles to determine which of the studies met all of the inclusion criteria. Where consensus could not be reached by discussion, a third reviewer (LK) acted as adjudicator until unanimity was achieved. Two reviewers (CM and MU) used the Scottish Integrated Guidelines Network (SIGN) critical appraisal tools [15] to assess the quality of the studies. Four reviewers worked in two pairs (MU and GP, LK and JS), using a standardised form, to extract data from the included studies. Extracted data included study design, setting and population, sample size, primary and secondary outcomes, and whether consequences affected staff, patients or the system, and causes and solutions were related to input, throughput or output factors. Disagreements were resolved by discussion until a consensus was reached, with the fifth reviewer (CM) available to act as arbitrator, if required. Details of the protocol for this systematic review were registered on PROSPERO [16] (S2 File).

Results

The database search returned 5,766 articles. Thirteen additional articles were added after searching the reference lists from identified studies, leaving a total of 4,131 articles after duplicates were removed. After the initial review of titles and abstracts, 162 full text articles were retrieved for full review, with 102 of these satisfying all of the inclusion criteria, and therefore included in the final review (Fig 1).

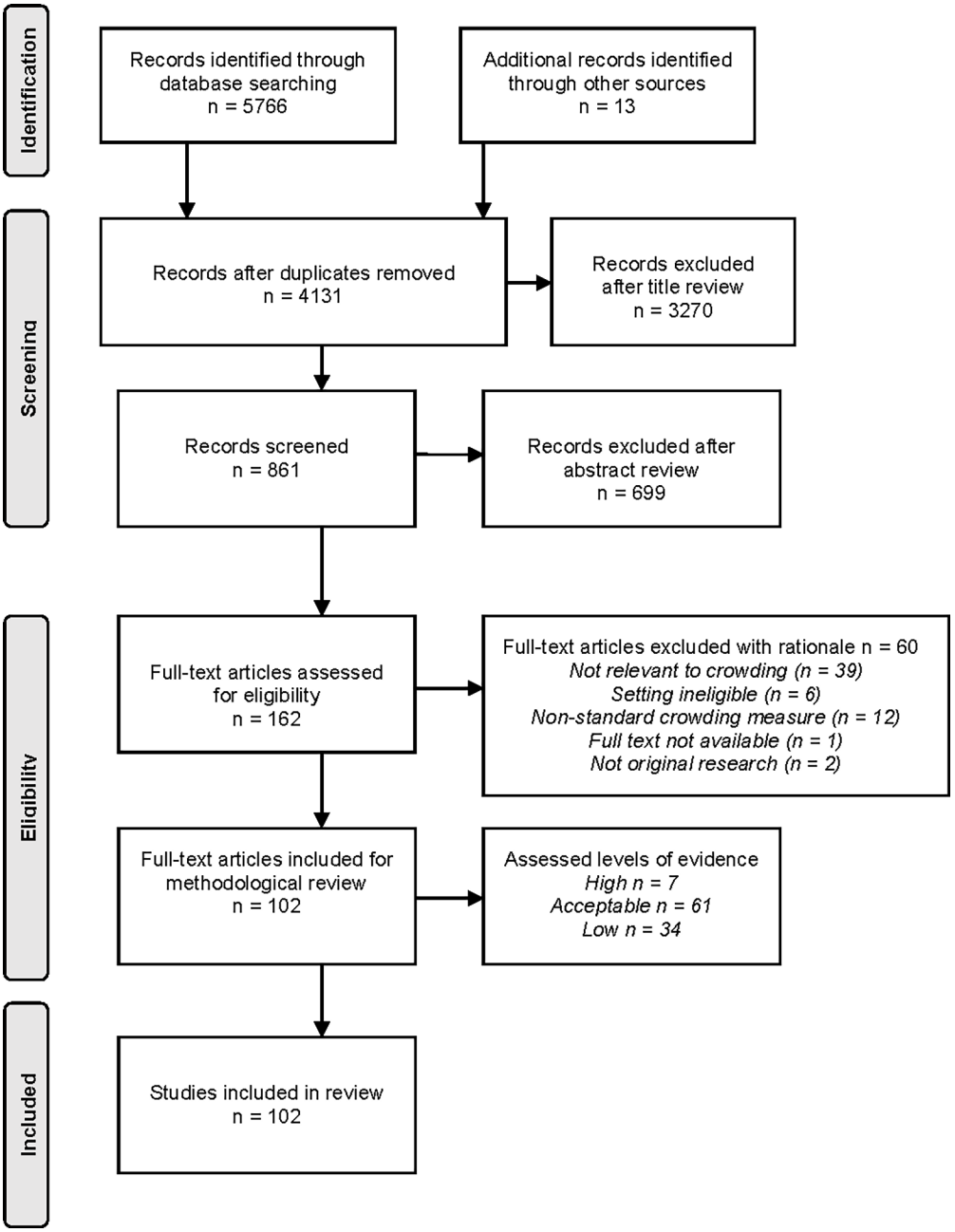

Fig 1. Preferred reporting items for systematic reviews.

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Study characteristics

The majority of studies were quantitative (95%) and retrospective in nature (87%), with eight prospective studies included, four each for studies investigating consequences [17–20] or solutions [21–24]. Four randomised control trials evaluating potential solutions were included [25–28], with the remaining studies being mixed-methods or statistical modelling. The majority of studies were from the USA (47%), Australia (18%) and Canada (9%), with 72% of studies having been published in the previous ten years (2009–2018). The largest proportion of studies addressed either the solutions to (51%) or consequences of (39%) ED crowding (Tables 1 and 2).

Table 1. Studies investigating potential solutions to reduce ED crowding (n = 52).

Author / Country /year	Design	Aim/s	Sample	Summary of intervention	Primary outcome measure/s	Level of evidence	Summary of findings
Anantharaman / Singapore / 2008 [32]	Retrospective cohort	To review the effects of 4 social interventions on ED utilisation		1. Three public education campaigns on proper use of ED 2. Financial disincentives for ED attendance 3. Redirection of non-emergencies from the ED 4. Provision of alternative clinics for those redirected and patients with minor complaints	Average non-emergency attendance	Low	1. Smaller reductions in non-emergency attendances post each campaign 2. Decrease in non-emergency attendances increased as ED fee increased 3. Number of patients redirected declined over time. Scheme ceased due to adverse public relations incidents 4. Decrease in non-emergency attendances seen with evening clinics, but time cost to ED showed no substantial benefit. Walk-in clinics had no impact on ED attendances
Arain / UK / 2015 [33]	Retrospective cohort and survey	To determine the impact of a GP-led WIC on the demand for ED care.	Minor attendances at 1 x Paediatric ED, 1 x Adult ED and 1 X MIU, 1 year pre and 1 year post opening of WIC 488 surveys competed	Opening of a GP-led WIC, 8:00–21:00 7 days a week	Minor attendances at 1 x Paediatric ED, 1 x Adult ED and 1 X MIU (Quant analysis) Attendances at the WIC by 'GP-Type' cases (Survey)	Acceptable	Significant 8.3% reduction in adult daytime GP-type attendances.
Arya / USA / 2013 [34]	Retrospective chart review	To determine the effect of a split-level ESI 3 flow model on LOS for all discharged patients.	20,215 pre 20,653 post	'Splitting' of patients with ESI 3 into low and high-variability	LOS for discharged patients.	Acceptable	Significant 5.9% reduction in LOS for all patients.
Asha / Australia / 2014 [35]	Pre-post, retrospective cohort	To determine if an emergency journey coordinator (EJC) improved NEAT compliance through resolving delays in patient processing	23,848 pre 20,884 post	Additional senior nursing role (EJC) in ED 7/7 from 14:30 to 23:00hrs. Conducted continuous rounds, focussed on patients approaching 2–3 hrs in ED, to identify delays and resolve issues to facilitate departure within 4 hrs	Proportion of patients meeting NEAT. ED occupancy. Ambulance transfer of care times. LWBS rates.	Acceptable	Significant 4.9% increase in patients meeting NEAT targets. Significant decrease of 2 patients in median ED occupancy. Non-clinically significant 56 second increase in ambulance transfer of care
Barrett / USA / 2012 [36]	Pre-post, retrospective, cohort	To assess the impact of a bed management strategy on boarding time of admitted patients in the ED	10,967 ED presentations	Implementation of new positions to ensure timely identification and allocation of inpatient beds. Improved communication around discharge and bed availability. Education for all clinical staff re new bed management policy.	EDLOS. Time from decision to admit until transfer to inpatient bed. LWBS rates. Hrs of ambulance bypass. Hold hrs (time >1 hr in ED post admission decision).	Low	21% reduction in mean EDLOS (admitted patients) 52% reduction in boarding time. 0.7% reduction in LWBS. 11% reduction in hrs of ambulance bypass. 61% reduction in hold hrs.

(*Continued*)

Table 1. (Continued)

Author / Country /year	Design	Aim/s	Sample	Summary of intervention	Primary outcome measure/s	Level of evidence	Summary of findings
Begaz / USA/ 2017 [27]	RCT	To assess the impact of initiating diagnostic tests from the ED waiting room for patients with abdominal pain on EDLOS	848 intervention 811 control	Stable patients (usually triage cat 3) with a chief complaint of abdominal pain randomised to either undergo diagnostic testing while in the waiting room or no testing until assigned an ED bed, following a rapid medical assessment on arrival	Time in an ED bed EDLOS LWBS rate	High	Significant 32 min reduction in mean time in an ED bed Significant 44 min reduction in mean EDLOS
Buckley / Australia / 2010 [37]	Retrospective time series analysis	To assess the impact of an after-hours GP (AH GP) clinic on the number of daily low-urgency presentations to ED	345,465 ED presentations	Opening of a user-pays AH GP clinic in a large regional centre with one ED	Daily ED presentations	Acceptable	Significant reduction of 7.04 patients per day (ATS 4&5) or 8.2% reduction in total presentations Daily increase of 1.36 patients (ATS 1,2 & 3) or 1.6% in total presentations
Burke / Australia / 2017 [38]	Prospective observational	To assess the impact of a new model of care on EDLOS	35,428 intervention 35,623 Control	Combines clinical streaming, team-based assessment and senior consultation	EDLOS NEAT compliance LWBS rate	High	Significant reduction in mean EDLOS Significant increase in proportion of patients meeting NEAT targets Significant reduction in LWBS rate
Burley / USA / 2007 [39]	Retrospective cohort	To assess whether quality improvement initiatives can improve flow for ED admitted patients	6 months pre, 6 months post	Consensus from key stakeholders that admitted patients not remain in ED ED patients given priority for inpatient beds Nurse handover faxed rather than telephoned Transportation staff placed in ED with priority given to admitted patients Two-tiered response to capacity limitations	Median time from bed request to assignment Median time from bed assignment to disposition EDLOS for admitted patients	Low	Significant reduction in median time from bed request to assignment in 3 of 6 months Significant reduction in median time from bed assignment to disposition in all months Significant reduction in median EDLOS in 5 of 6 months
Burström / Finland / 2016 [40]	Pre-post, retrospective, cohort	To assess the impact of Physician led triage on efficiency and quality in the ED	20,023 pre 23,765 post	Senior physician and nurse triage all newly arrived patients. Next a team of junior physician, I x RN and 1 x nursing assistant care for patient following a detailed protocol to preform standardised work	Multiple time measures LWBS Unscheduled returns (24 and 74 hr) Mortality (7 and 30 day)	Low	Significant decreases in: EDLOS LWBS rates Unscheduled returns Mortality within 7 and 30 days of first visit

(*Continued*)

Table 1. (Continued)

Author / Country /year	Design	Aim/s	Sample	Summary of intervention	Primary outcome measure/s	Level of evidence	Summary of findings
Cha / Korea / 2015 [41]	Retrospective cohort	To determine the long-term effects of an independent capacity protocol (ICP) on ED crowding metrics	271,519 ED presentations over 6 years, 3 years pre, 3 years post	ICP converted ED into temporary, nonspecific ward. ED physicians assisted by specialists in determining disposition. When condition allowed, patients transferred to surrounding community hospitals.	EDLOS	Low	Significant decrease in EDLOS
Chang / USA / 2018 [24]	Mixed Method	To identify strategies among high-preforming, low-preforming, and high preforming improving hospitals to reduce ED crowding		No intervention. Interview data from 60 key leaders in 4 high-performing (top 5%), 4 low-performing (bottom 5%), and 4 improving hospitals		Low	No specific strategies identified. Identified 4 organisational domains associated with high performance hospitals; executive leadership involvement, hospital-wide coordinated strategies, data-driven management and performance accountability
Copeland / Canada / 2015 [42]	Pre-post, retrospective, cohort	To determine if ED fast-track (FT) is an efficient strategy to reduce wait times in a single physician coverage ED	7,432 ED visits	Open from 09:00–21:00hrs. 5 acute beds plus some chairs allocated to FT. Specially trained triage nurses allocated patients to either acute care or FT. Once a number of FT patients together, physician assessed and treated sequentially.	Wait time LOS	Acceptable	Significant 6 min reduction in medium wait time Significant 3.6% increase in patients meeting Canadian standard time guidelines
Dolton / UK / 2016 [43]	Retrospective, case control	To evaluate the impact of a pilot of 7-day opening of GP practices on ED attendances	4 pilot GP practices 30 'control' practices	4 geographically dispersed GP clinics opened 7 days a week. Advertised in local area and at the local ED	ED attendance	Acceptable	Significant 9.9% drop in total ED attendances Significant 17.9% drop in weekend ED attendances
Douma / USA / 2016 [28]	RCT	To evaluate the effect of 6 nurse-initiated protocols on ED crowding	67 control 76 intervention	6 updated protocols for nurse-initiated treatment commenced. Training provided to 30 nursing staff on protocol use.	Time to diagnostic test Time to treatment EDLOS	Low	Significant 186 min reduction in time to analgesic administration Significant 79 min reduction in time to troponin measurement Significant reduction in EDLOS for 3 of 6 protocols

(*Continued*)

Table 1. (Continued)

Author / Country /year	Design	Aim/s	Sample	Summary of intervention	Primary outcome measure/s	Level of evidence	Summary of findings
^Estey / Canada / 2003 [31]	Exploratory field study	To describe the perceptions of health care professionals on potential solutions to ED crowding	Seven focus groups representing all 7 EDs in the region.	Suggestions from focus groups, no intervention		Low	Increased test turnaround-time (TAT). Better ED staffing. Faster response from admitting teams. Holding unit for admitted patients More inpatient beds 24hr outpatient appointments.
Fulbrook / Australia / 2017 [44]	Non-randomised controlled trial	To assess the effect of a nurse navigator role on NEAT performance	9,822 intervention 9,951 control	Nurse navigator worked 12:30–20:30 on a week-on, week-off basis for 20 weeks.	NEAT compliance EDLOS	Acceptable	Significant increase in proportion of patients meeting NEAT targets Significant reduction in mean EDLOS
Han / USA / 2008 [45]	Pre-post, retrospective, cohort	To determine the impact of physician triage on ED crowding measures	8, 569 ED visits pre 8,569 ED visits post	After nurse triage, a dedicated physician initiated diagnostics and treatments of patients in the waiting room, 7/7 between 13:00–21:00hrs	EDLOS LWBS rates Ambulance diversion hrs	Acceptable	Significant 14 min reduction in EDLOS for discharged patients Significant 2% reduction in LWBS rates Reduction in ambulance diversion hrs
Holroyd / USA / 2007 [25]	RCT	To evaluate the implementation of triage liaison physician (TLP) shifts on ED crowding	136 shifts: 2,831 ED presentations (intervention) 133 shifts: 2,887 presentations (control)	3 x 2 week blocks where shifts randomly allocated to TLP shifts versus not (11:00–20:00hrs) TLP mitigated factors impeding throughput including: supported/assisted triage nurses, evaluated ambulance patients, initiated diagnostic studies	EDLOS LWBS rates	High	Significant 36 min decrease in EDLOS LWBS rates decreased significantly from 6.6 to 5.4%.
Howell / USA / 2008 [46]	Pre-post, retrospective, cohort	To measure the impact of an 'active bed management' intervention on EDLOS and ambulance diversion hrs	17,573 ED visits pre 16,148 ED visits post	Dedicated physician role, working in 12 hr shifts, 24/7. Physician freed from all other clinical duties. Assessed real time bed availability and made collaborative triage decisions re optimal clinical setting for patient's requiring admission. New bed director position who could call in extra staff and admit patients outside of speciality area.	Admitted and discharged EDLOS	Acceptable	EDLOS for admitted patients reduced by 98 min, with no change for discharged patients Reduction in ambulance diversion hrs

(*Continued*)

Table 1. (Continued)

Author / Country /year	Design	Aim/s	Sample	Summary of intervention	Primary outcome measure/s	Level of evidence	Summary of findings
Imperto / USA / 2012 [47]	Pre-post, retrospective, cohort	To determine if physician-in-triage (PIT) improves ED patient flow	17,631 patients	After nurse triage, PIT assessed and ordered diagnostics and treatments as required. Tasks performed by an RN and technician assigned to PIT.	Time to physician evaluation Median LOS Time to disposition decision LWBS rate	Acceptable	Significant reductions in: Median time to physician Median EDLOS Hrs on ambulance bypass
Jang / USA / 2013 [26]	RCT	To compare EDLOS between patients assigned to metabolic Point-of-care testing (POCT) versus central laboratory testing	10,244 patients	Patients randomised to either POCT or central laboratory testing	EDLOS	High	Reduced median EDLOS by 20 min in patients assigned to POCT
Jarvis / UK / 2014 [21]	Prospective, observational, cohort study	To compare the impact of an emergency department intervention team (EDIT) with a traditional nurse triage model on EDLOS	3,835 control 787 intervention	All ED patients assessed by EDIT Nurse history, observations and administration of initial treatments, compilation and execution of an investigation plan. All discharged patients thoroughly examined by consultant. POCT utilised as appropriate. Non-discharged patients transferred to central cubicle area for traditional care	'Time to ED ready' (i.e. time from registration to time all ED care complete). Time from arrival to first contact with clinical staff. Time from arrival to start of assessment by member of clinical staff.	High	Significant 53 min decrease in median time to ED ready Significant 8 min decrease in median time to assessment by member of clinical staff
Jones / NZ / 2017 [48]	Retrospective cohort	To assess for changes in clinically relevant outcomes after the introduction of a national target for EDLOS	5,793,767 ED presentations 2,082,374 elective admissions to 18 of 20 potential district health boards	Nationally mandated that 95% of ED presentations would be admitted, discharged or transferred within 6 hrs of arrival. Wide variety of process, staffing and structural changes implemented at different hospitals	EDLOS IPLOS ED representations $\leq$ 48 hrs Readmissions $\leq$ 30 days Access block	Acceptable	Significant reduction of $^{\#}$0.29 days in median IPLOS Significant reduction of $^{\#}$1.1 hrs in median EDLOS No change in ED representations $\leq$ 48 hrs Significant $^{\#}$1% increase in readmissions $\leq$ 30 days Significant $^{\#}$27% reduction in access block $^{\#}$Determined *a priori* to be of clinical significance
Kelen / USA / 2001 [22]	Prospective, pre-post, observational	To determine the impact of an inpatient, ED-managed acute care unit (ACU) on ED overcrowding	10,871 ED presentations, 1,587 patients in the ACU (14.4% of ED census)	Opening of a 14-bed monitored unit, located at a distance remote to the ED, within the hospital. Staffed by ED personnel. Designed to accept ED patients who required observation or management for >4 hrs.	LWBS rates. Hrs of ambulance diversion.	Acceptable	Significant decrease in LWBS rates. Significant decrease in hrs of ambulance diversion.

(*Continued*)

Table 1. (Continued)

Author / Country /year	Design	Aim/s	Sample	Summary of intervention	Primary outcome measure/s	Level of evidence	Summary of findings
Kim / Korea / 2012 [49]	Retrospective cohort	To evaluate the effects of a short text message reminder to decision makers who delay assessing patients in the ED on EDLOS	1,693 consulted patients pre 1,642 consulted patients post	2-4-8 SMS project When no decision on patient disposition entered on computer 2 hrs post referral, SMS reminder sent to resident. Same at 4 hr mark. Admissions delayed 8 hrs, SMS sent to relevant faculty/admissions office	EDLOS Consultation time Disposition time Boarding time	Low	Significant 36 min reduction in median EDLOS for admitted patients No effect on consultation time Significant decreases in disposition and boarding time
Lauks / Holland / 2016 [50]	Pre-post, retrospective, cohort	To assess the impact of implementing medical team evaluation (MTE) in the ED	47,743 ED visits	Physician teamed with a triage nurse, 7/7, between 09:00–22:00hrs. Physician initiated diagnostics and treatments and discharged ESI 5 patients.	Door-to-doctor time EDLOS	Acceptable	Significant 30 min decrease in median door-to-doctor time Significant 15 min increase in median EDLOS
Lee / Taiwan / 2017 [51]	Retrospective cohort	To assess the impact of high turnover 'ED utility beds' on ED crowding	70,515 control 69,706 intervention	14 beds for ED patient use only with strict regulations to govern occupancy. Restriction of 48-hr limit for each patient	EDLOS LWBS rates	Acceptable	Significant 1.7 hr decrease in mean EDLOS for all admitted non-trauma patients No change in EDLOS for discharged patients No change in rates of LWBS
Lee-Lewandrowski / USA / 2003 [52]	Pre-post, retrospective, cohort	To investigate the impact of a POCT satellite laboratory in the ED	369 patients	Clinicians had option of central laboratory or POCT for urinalysis, pregnancy testing, cardiac markers and glucose	Test TAT EDLOS	Low	87% reduction in test TAT Significant 41 min decrease in EDLOS for combined patients having 3 tests (excluding glucose) No significant decrease for patients having single test EDLOS for patients who did not receive POCT increased by non-significant 11 min
Lee-Lewandrowski / USA / 2009 [53]	Pre-post, retrospective, cohort	To evaluate the impact of implementing rapid D-dimer testing in an ED satellite laboratory	252 patients pre 211 patients post	24 hr satellite laboratory in the ED had ability to undertake rapid D-dimer testing	Test TAT EDLOS	Low	79% decrease in test TAT Significant 1.32 hr decrease in mean EDLOS for patients who received D-dimer testing
Mason / UK / 2011 [54]	Retrospective data analysis	To evaluate the effect of the mandated ED care intervals in England	735,588 ED visits from 15 hospitals over 4 years. Mix of high, middle and low performing	Nationally mandated 4 hr target for patient disposition for 98% of ED presentations. Specific interventions not detailed but hospitals expected to adopt a whole-systems approach	EDLOS Time to first ED clinician review	Acceptable	Proportion leaving ED within 4 hrs increased from 83.9 to 96.3% Median EDLOS for admitted patients decreased by 25 min

(*Continued*)

Table 1. (Continued)

Author / Country /year	Design	Aim/s	Sample	Summary of intervention	Primary outcome measure/s	Level of evidence	Summary of findings
McGrath / USA / 2015 [55]	Retrospective cohort	To evaluate the impact of a flexible care area (FCA) on ED throughput measures	417 days over 2 years when FCA was operational	3 roomed area staffed by ED physician, RN and ED technician from 16:00–23:00hrs. Prioritised moderate acuity to expedite ordering of diagnostics	EDLOS LWBS rate	Low	Significant decrease in EDLOS for some ESI categories Significant reduction in rates of LWBS
McHugh / USA / 2013 [56]	Retrospective, cross-sectional	To evaluate the efforts of five hospitals (a-e) that introduced various interventions to reduce ED crowding		a. PIT b. Faxed report from ED to admitting unit and bed coordinator c. Adoption of ESI triage scale, bedside registration and staff resourcing for ED fast-track area d. More efficient intake process for non-urgent patients e. Improved process to request specialist consults	EDLOS LWBS rates	Low	a. Significant reduction in EDLOS for mid-acuity patients (target group) b. Significant reduction in LWBS rates c. Significant reduction in EDLOS d. Significant reduction in EDLOS e. Increase in EDLOS
Mumma / USA / 2014 [57]	Retrospective cohort	To determine the effects of ED expansion on ED crowding	42,896 pre 48,358 post	ED expanded from 33 to 53 beds No substantial changes to physician staffing or nurse/ technician to patient ratios	LWBS rates Daily boarding hrs	Low	No change in LWBS rates Significant increase in boarding hrs from 160 hrs per day to 180 hrs per day
Nagree / Australia / 2004 [58]	Retrospective, cohort	To model the capacity of after-hours GP services to reduce low acuity presentations (LAPs) to metropolitan EDs	183, 424 ATS 3–5 patients	No intervention. Modelling the impact of AH GP services	Excess LAPs	Acceptable	After-hours GP services for LAPs are unlikely to significantly reduce total ED attendances or costs
Ngo / Australia / 2018 [59]	Retrospective cohort	To assess the impact of the Western Australia (WA) 4 hr target on ED functioning and patient outcomes	3,214,802 ED presentations across 5 hospitals (2002–2013)	Implementation of a 4 hr rule (NEAT) whereby 90% of ED patients in the state of WA were to be admitted, discharged or transferred within 4 hrs of arrival	Access block ED occupancy rate ED re-attendances $\leq$ 1 week EDLOS	Acceptable	Significant decrease in percentage of access block at all hospitals Significant decrease in median ED occupancy at 4 of 5 hospitals Significant decrease in median EDLOS at 4 of 5 hospitals
Partovi / USA / 2001 [60]	Retrospective, cohort	To investigate the effect of Faculty triage on EDLOS	8 intervention days 8 'control' days	A faculty member was added to the triage team of 2 nurses and one emergency medicine technician. Their role included: rapid evaluation, move serious patients to main area, order diagnostics and fluids, discharge simple cases and encourage rapid registration	Nurse triage time Nurse discharge time LWBS rates	Low	Significant 82 min reduction in mean EDLOS

(*Continued*)

Table 1. (Continued)

Author / Country /year	Design	Aim/s	Sample	Summary of intervention	Primary outcome measure/s	Level of evidence	Summary of findings
Patel / USA / 2014 [61]	Pre-post, retrospective, cohort	To assess the effect of a leadership-based program to expedite hospital admissions from the ED	25 months pre 47 months post	Team of hospital leaders convened. Computerised tracking system used to monitor ED bed status in real time. Agreement to admit patients within 1 hr of decision to admit	Proportion of ED patients admitted to inpatient bed within 60 mins of bed request	Acceptable	Significant 16% increase in proportion of patients admitted within 60 mins of bed request
Perera / Australia / 2014 [62]	Pre-post, retrospective, cohort	To assess the effect of NEAT on common crowding metrics	76,935 patients	Hospital-wide education program to increase awareness of NEAT initiative	EDLOS IPLOS Proportion of admissions meeting NEAT Mortality rates	Acceptable	Significant improvements in: EDLOS NEAT admission targets Access block Significant increase in IPLOS No change to mortality rates
Quinn / USA / 2007 [63]	Pre-post, retrospective, cohort	To determine the impact of a rapid assessment policy (RAP) on EDLOS	10,153 pre 10,387 post	ED physicians directly admit patients to inpatient beds. Admitting physicians not required to assess patients in the ED prior to admission No requirement for all laboratory and radiological test results to be complete prior to admission	EDLOS Time on ambulance diversion. LWBS rates.	Acceptable	Significant 10 min decrease in EDLOS Significant 65% decrease in hrs of ambulance diversion
Sharma / Australia / 2011 [64]	Statistical modelling	To model the determinants of duration of wait of ATS 2 patients in an ED and test whether diverting ATS 5 patients away from the ED, or increasing ATS 5 patients' choice of EDs reduces ED waiting times for ATS 2 patients.	84,291 ATS 2 199,973 ATS 5	No intervention. Modelling the impact of co-located GP and choice of ED for ATS 5 patients on outcomes for ATS 2 patients	EDLOS	Low	Co-located GP significantly reduced mean wait of ATS 2 patients by 19% Increasing choice of ATS 5 patients beyond a certain number of ED options had a negative effect on duration of wait for ATS 2 patients
Shetty / Australia / 2012 [23]	Prospective, interventional	To assess the impact of the 'Senior Streaming Assessment Further Evaluation after Triage (SAFE-T) zone' concept on ED performance	10,185 pre 10,713 post	Developed an assessment zone around triage to facilitate early physician review, disposition decision-making, and streaming to bypass the ED acute area	EDLOS LWBS rates	High	Significant reductions in: EDLOS for ATS 2–5 LWBS rates

(*Continued*)

Table 1. (Continued)

Author / Country /year	Design	Aim/s	Sample	Summary of intervention	Primary outcome measure/s	Level of evidence	Summary of findings
Shin / Korea / 2017 [65]	Retrospective cohort	To measure the effect of an improved speciality consultation process on EDLOS	6,967 pre 7,301 post	Between 7am and 6pm only senior emergency physicians (as opposed to emergency residents) consult internal medicine (IM) physicians re patients requiring admission. If required, the IM physician reviews the patient in the ED and organises prompt resident review for admission	EDLOS of IM patients Admission order to ED departure Overall EDLOS Discharged EDLOS	Acceptable	Significant 290 min reduction in mean EDLOS Significant 120 min decrease in mean time from admission order to ED departure No change to overall EDLOS No change to discharged EDLOS
Singer / USA / 2008 [66]	Retrospective, cohort	To investigate the effect of a dedicated ED 'stat' laboratory on EDLOS	5,631 ED visits pre 5,635 ED visits post	A stat laboratory dedicated to ED patents set up within the main laboratory, staffed by dedicated personnel, 24/7	EDLOS for admitted patients	Low	Significant 21 min reduction in median EDLOS for all patients with laboratory tests performed Significant 62 min reduction in median EDLOS for admitted patients with laboratory tests performed
Sullivan / Australia / 2014 [67]	Retrospective, pre-post, interventional	To evaluate the effect of various reforms (throughput and output) to meet the NEAT target of disposition from ED within 4 hrs	All ED presentations for the same 3-month periods in 2012 (pre), 2013 (post) and 2014 (maintenance)	Senior staff taskforce set up to provide oversight, direction and monitor NEAT compliance. Business intelligence unit set up to make reporting transparent. Compliance seen as whole-of-hospital flow problem. Major redesign of clinical processes, including bed management operations	Proportion of patients exiting ED within 4 hrs Mean transit times within the ED Inpatient mortality LWBS rates 48 hr representation rates	Acceptable	Significant increase in: Proportion of patients exiting ED within 4 hrs Mean transit times within the ED Significant decrease in: Inpatient mortality LWBS rates
Takakuwa / USA / 2006 [68]	Retrospective, cohort	To investigate the effect of bedside registration on EDLOS	52,225 patient encounters	When beds were available, patients brought immediately back to patient care area following triage where they were registered by a clerk whilst being simultaneously assessed by medical staff	Time from triage-to-room Time from room-to-disposition	Low	Significant decrease in time from triage-to room with bedside registration for non-urgent patients

(*Continued*)

Table 1. (Continued)

Author / Country /year	Design	Aim/s	Sample	Summary of intervention	Primary outcome measure/s	Level of evidence	Summary of findings
Tenbensel / NZ / 2017 [69]	Mixed method	To assess the impact of a national 6 hr target for ED admissions on EDLOS To identify particular actions that impacted on identified reductions in EDLOS	4 hospitals covering 25% of NZ population 68 semi-structured interviews	Nationally imposed target of 95% of all ED presentations seen, treated or discharged within 6 hrs	Reported EDLOS Total EDLOS (includes time in short-stay unit) Staff perceptions of successful interventions	Acceptable	Reductions in median reported EDLOS in all hospitals Smaller reductions in median total EDLOS in all hospitals ***Results from interviews*** Hospital leadership prior to target New resources (beds and staff) Processes to improve flow within the ED and hospital wide Improved information and communication
van der Linden / Holland / 2013 [70]	Retrospective, cohort	To investigate the effect of a flexible acute admissions unit (FAAU) on EDLOS for admitted patients and inter-hospital transfers	8,377 ED visits pre 8,931 ED visits post	Between 4pm and 8am daily at least 15 potential FAAU beds were identified across several inpatient units. During office hours, patients were transferred back to 'home' departments where possible. Employment of an 'admissions coordinator' who assessed the bed status in real time	Number of admissions transferred to other hospitals EDLOS for patients requiring 'regular' admission (non-specialist) EDLOS for discharged patients	Low	Significant decrease in number of patients transferred to other hospitals due to bed unavailability No change in EDLOS for patients admissible to FAAU in comparison to increased EDLOS for 'other' admissions
^van der Linden / Holland / 2017 [20]	Mixed Method	To compare staff perceptions of causes and solutions of ED crowding in two EDs: one in Pakistan and one in The Netherlands	18 one-hour staff interviews 12 in Pakistan 6 in The Netherlands	Suggestions from interviews, no intervention		Low	An additional triage room More staff to reduce delays in decision to admit More efficient processes for bed management and diagnostics An acute admissions unit More effective bed coordination
^White / USA / 2012 [71]	Pre-post, retrospective, cohort	To assess the impact of 'Supplemented Triage and Rapid Treatment' (START) on ED throughput	12,936 pre 14,220 post	After nurse triage, non-FT patients assessed by a physician who ordered diagnostics and identified patients whose disposition could be accelerated without further need for clinical work-up in the ED.	EDLOS LWBS rates	Acceptable	Significant decrease in: Median EDLOS LWBS rates

(*Continued*)

Table 1. (Continued)

Author / Country /year	Design	Aim/s	Sample	Summary of intervention	Primary outcome measure/s	Level of evidence	Summary of findings
Whittaker / UK / 2016 [72]	Retrospective cohort	To investigate the association between extending GP opening hrs and ED visits for minor injuries	2,945,354 ED visits	4 'schemes' (each scheme serves population of 200–300,000 people) received funding to provide additional urgent and routine GP appointments between 5-9pm Mon-Fri and on both days of the weekend	Per capita (per 1,000) patient-initiated ED referrals for minor problems Total ED visits	Acceptable	Significant 26% relative reduction in patient-initiated ED referrals for minor problems in intervention practices Insignificant 3.1% relative reduction in total ED visits
Willard / USA / 2017 [73]	Retrospective cohort	To examine the effectiveness of a Full Capacity Protocol (FCP) to reduce ED crowding	20,822 ED encounters control 22,357 ED encounters intervention	A predetermined response to specific circumstances in the hospital and ED. Additionally, can be activated by ED coordinator in response to reduced throughput. When activated, hospital leaders gather in ED to collaboratively identify and remove barriers to obtaining disposition.	LWBS rates EDLOS Ambulance diversion hrs	Acceptable	10.2% non-significant decrease in LWBS rates Significant 34 min increase in mean EDLOS Significant 92% decrease in total hrs of ambulance diversion

^Papers also looked at causes of crowding

ACU = acute care unit AH = after hours ATS = Australian triage scale ED = emergency department EDIT = emergency department intervention team EDLOS = emergency department length of stay EJC = emergency journey coordinator ESI = emergency severity index FAAU = flexible acute admissions unit FCA = flexible care area FCP = full capacity protocol FT = fast-track GP = general practitioner ICP = independent capacity protocol IM = internal medicine IPLOS = inpatient length of stay LAP = low-acuity presentation LOS = length of stay LWBS = left without being seen MIU = minor injury unit MTE = medical team evaluation NEAT = National Emergency Access Target PIT = physician in triage POCT = point-of-care test RAP = rapid assessment policy RN = registered nurse SMS = short-message-service TAT = turnaround-time TLP = triage liaison physician WIC = Walk-in centre

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Only 14 included studies (14%) investigated potential causes (Table 3). Two studies looked at both causes and consequences [29, 30], and two studies investigated causes and potential solutions [20, 31].

Study quality

The SIGN appraisal tools guidelines [15] recommend that all retrospective or single cohort studies receive a rating of no higher than 'acceptable'. Consequently, the majority of the included studies (59%) were rated as being of acceptable quality. The remaining studies were rated as high (7%) and low (34%) quality. The main area of weakness was inadequate consideration of potential confounders, leading to uncertainty about claims of cause and effect. The level of statistical analysis was often basic, with confidence intervals frequently absent in the reporting of results and few multivariate analyses. Similarly, although percentage and time improvements were frequently noted, often there was no indication whether or not the improvement values were statistically significant. Two survey studies [29, 30], one focus group study [31], and two interview studies [20, 24] without confirmatory numerical data, were also included. Furthermore, with the exception of one study [19], all of the 40 studies that

Table 2. Studies investigating potential consequences of ED crowding (n = 40).

Author/ Country /year	Design	Aim/s	Sample	Primary outcome measure/s	Level of evidence	Summary of findings
*Bond / Canada / 2007 [29]	Non-comparative survey	To investigate the frequency, determinants and impacts of ED crowding	158 ED Directors	Frequency, determinants and impacts of ED crowding	Low	Increased stress of clinical staff Increased wait times Provider dissatisfaction Risk of poor patient outcomes and delay in improvements in patients' wellbeing
Chiu / Taiwan / 2018 [74]	Retrospective cohort	To investigate the effect of crowding on clinical efficiency, diagnostic tool use and patient disposition	70,222 ED visits in 2 EDs	Time to disposition decision EDLOS Patient disposition Diagnostic interventions ordered	Acceptable	Increased odds of being admitted in times of crowding Slightly increased odds of CT scanning and laboratory testing during crowding
*Derlet / USA / 2002 [30]	Non-comparative survey	To determine the incidence, causes and effects of crowding in EDs in three US states	210 ED directors	Incidence, causes and effects of ED crowding	Low	Delayed commencement of therapy across a range of conditions leading to poor outcomes for patients
Diercks / USA / 2007 [75]	Secondary data analysis from an observational registry	To evaluate the association between EDLOS, guideline-adherence to recommended therapies and clinical outcomes of patients presenting to the ED with non-ST-segment-elevation myocardial infarction (non-STEMI)	42,780 patients with non-STEMI	Adherence to 5 acute guideline medication recommendations (defined as receiving medications within 24 hrs) Occurrence of in hospital adverse events (death, recurrent MI)	Acceptable	Long ED stays associated with decreased use of guideline-recommend therapies and a higher risk of recurrent MI No observed increase in inpatient mortality
Fee / USA / 2007 [76] '	Retrospective cross-sectional, chart review	To determine the association between ED volume and timing of antibiotic administration in patients admitted via the ED with community acquired pneumonia (CAP)	405 patients with CAP	Did/did not receive antibiotics within 4 hrs in relation to total ED volume. Time to antibiotics in relation to number of patients in the ED who were ultimately admitted.	Acceptable	Higher ED volume independently associated with a lower likelihood of patients with CAP receiving antibiotics within 4 hrs (OR 0.96 per additional patient). Number of patients in the ED ultimately admitted had a slightly stronger, but non-significant, effect than the number of patients ultimately discharged, on time to antibiotics (OR 0.93 Vs 0.97).
Gaieski / USA / 2017 [77]	Retrospective cohort	To investigate the hypothesis that ED crowding would impact negatively on the care of patients with severe sepsis or septic shock	2,913 patients with severe sepsis	Time to administration of intravenous fluids (IVF) Time to administration of antibiotics Initiation of protocolized care (Y/N) Inpatient mortality	Acceptable	ED occupancy had significant negative impact on odds of patients receiving IVF within $\leq$ 1 hr and antibiotics within $\leq$3 hrs Number of boarders in the ED had significant negative impact on the odds of receiving protocolized care No impact on inpatient mortality
Guttmann / Canada / 2011 [3]	Retrospective cohort	To determine whether patients discharged from the ED during shifts with long waiting times are at risk for adverse events	13,934,542 patients discharged from ED	Admission to hospital or death within seven days	Acceptable	Patients presenting to EDs during shifts with long mean waiting times might be at increased risk of death and admission in subsequent 7 days, regardless of acuity on presentation

(*Continued*)

Table 2. (Continued)

Author/ Country /year	Design	Aim/s	Sample	Primary outcome measure/s	Level of evidence	Summary of findings
Hwang / USA / 2006 [78]	Retrospective cohort	To evaluate the effect of ED o/c on assessment and treatment of pain in older adults with a hip fracture	158 patients	Documented pain assessment Time to pain assessment Documentation and administration of analgesic Type of analgesic administered	Low	When the ED was at >120% capacity there was a significant reduced odds of patients having their pain documented on first assessment and a longer time to pain assessment. No impact on time to administration of analgesic
Hwang / USA / 2008 [79]	Retrospective cohort	To evaluate the association of ED crowding factors with quality of pain care	1,068 ED visits	Time to documented pain assessment Time to medications ordered and administered Type of analgesia ordered	Acceptable	ED census directly associated with significant delays in: Pain assessment Time to analgesic ordering and administration
Jo / Korea / 2015 [80]	Retrospective cohort	To evaluate the association between ED crowding and inpatient mortality among critically ill patients admitted through the ED	1,801 critically ill patients (systolic BP<90mmHg)	Inpatient mortality	Acceptable	ED crowding associated with increased inpatient mortality
Kulstad / USA / 2009 [81]	Retrospective cohort	To determine the association between percutaneous coronary angiogram (PCI) for patients presenting to ED with an acute myocardial infarction (AMI) and ED crowding	17 patients who underwent PCI over a 2-month period	Time to first Electro-cardiogram (ECG) Time to arrival at cardiac catheterisation lab (CCL) Time to first balloon inflation	Low	No relationship between time to ECG and time to arrival in the CCL and crowding Significant delay in time to balloon inflation during times of crowding (p = 0.008)
Kulstad / USA / 2010 [17]	Prospective, observational	To determine the association between ED crowding and the frequency of medication errors	6,728 EDWIN scores and 283 medication errors	Correlation between the average daily EDWIN score and total number of daily medication errors detected	Low	Significant positive correlation between average daily EDWIN score and medication error frequency (p = 0.001)
Lee/ Taiwan / 2012 [18]	Prospective, chart review	To investigate the factors related to blood culture contamination in the ED	558 patients with positive blood cultures	Rates of contaminated blood cultures in relation to ED crowding as measured by the NEDOCS	Low	ED overcrowding independently associated with contaminated blood cultures (OR 1.58, p = 0.04). Strong correlation between contamination rate and degree of ED crowding (Pearson correlation = 0.99, p = 0.001)
Liew / Australia / 2003 [82]	Retrospective cohort	To examine the association between EDLOS and IPLOS	17,954 admissions	Mean IPLOS Excess IPLOS	Low	EDLOS is associated with excess IPLOS
Liu / USA / 2011 [83]	Retrospective cohort	To examine the relationship between ED boarding and quality of care amongst patients admitted for chest pain, pneumonia or cellulitis	1,431 patients included	Medication delays and errors. Adverse events.	Acceptable	Boarding time associated with home medication delays (AOR 1.07 CI 1.05–1.10)
McCarthy / USA / 2009 [84]	Retrospective cohort	To quantify the relationship between ED crowding and EDLOS	235,928 ED visits at 4 EDs	Waiting room time Treatment time Boarding time	Acceptable	Crowding delayed waiting room and boarding time but not treatment time Crowding delayed the care of ATS 2 patients at all sites
McCusker / Canada / 2014 [85]	Retrospective cohort	To examine the association of ED occupancy with patient outcomes	677,475 patients at 42 EDs	Deaths at 30 days for both admitted and discharged patients Return ED visits for discharged patients Admission following return ED visit	Acceptable	A 10% increase in ED bed relative occupancy ratio was associated with a significant 3% increase in death

(*Continued*)

Table 2. (Continued)

Author/ Country /year	Design	Aim/s	Sample	Primary outcome measure/s	Level of evidence	Summary of findings
Medley / USA / 2012 [86]	Retrospective chart review	To determine if there is an association between ED occupancy rates and violence towards ED staff	278 included cases	The presence of violent incidents	Acceptable	A significant association between crowding and violence towards staff
Mills / USA / 2009 [87]	Secondary data analysis from a prospectively collected database	To evaluate the association between ED crowding and analgesic administration in adult ED patients with acute abdominal pain	976 patients with abdominal pain	Receipt of analgesia Delays in administration of analgesia	Acceptable	ED crowding not associated with failure to treat with analgesia Higher crowding levels in ED independently associated with significant delays in administration of analgesia
Nippak / Canada / 2014 [88]	Retrospective cohort	To identify the relationship between EDLOS and IPLOS	4,743 ED visits	EDLOS IPLOS	Low	Positive significant correlation between EDLOS and IPLOS
Pines / USA / 2006 [89]	Cross-sectional, data-linkage	To assess the association between ED crowding and antibiotic timing in pneumonia and PCI in AMI	Administrative data from 24 EDs	Time to antibiotic administration in patients with pneumonia Time to PCI in patients with AMI	Low	An increase in overall EDLOS associated with a significant decrease in percentage of patients receiving antibiotics within 4 hrs ($p = 0.04$) No association between ED crowding measured and time to PCI for patients with AMI
Pines / USA / 2007 [90]	Retrospective cohort	To assess the impact of ED crowding on delays in antibiotic administration for patients with community acquired pneumonia (CAP)	694 patients with CAP	Time from patient triage until antibiotic administration	Acceptable	Crowding in the ED is related to delayed and non-receipt of antibiotics in patients with CAP
Pines / USA / 2008 [91]	Retrospective cohort	To study the impact of ED crowding on ED patients with severe pain	13,758 patients	Receipt of any analgesia Delay of >1 hour from triage to receipt of analgesia Delay of >1 hour from arrival in a treatment room to receipt of analgesia	Acceptable	Increasing levels of ED crowding were significantly associated with failure to treat or delayed treatment with analgesia
Pines / USA / 2009 [92]	Retrospective cohort	To examine whether ED crowding was associated with adverse cardiovascular outcomes in patients with chest pain syndrome	4,574 patients	The development of an adverse cardiovascular outcome that was not present on ED arrival, but that occurred during hospitalisation	Acceptable	A positive association between some measures of ED o/c and rates of adverse cardiovascular outcomes
Pines / USA / 2010 [93]	Retrospective cohort	To study the association between ED crowding and the use of, and delays in administration of analgesia in patients with back pain	5,616 patients	Receipt of any analgesic Time to administration of analgesia	Acceptable	Higher crowding levels in the ED independently associated with significant delays in analgesia administration
Reznek / USA / 2016 [94]	Retrospective cohort	To investigate the hypothesis that ED crowding is associated with longer door-to-imaging time (DIT) in patients with acute stroke	463 patients	DIT $\leq$ 25 mins (Y/N)	Acceptable	Crowding had a significant negative impact on DIT
Richardson / Australia / 2002 [95]	Retrospective cohort	To assess the relationship between access block in the ED and IPLOS	11,906 admissions	EDLOS and IPLOS	Acceptable	Patients who experienced access block had a significant mean IPLOS 0.8 days longer than those who did not experience access block

(*Continued*)

Table 2. (Continued)

Author/ Country /year	Design	Aim/s	Sample	Primary outcome measure/s	Level of evidence	Summary of findings
Richardson / Australia / 2006 [96]	Retrospective stratified cohort	To quantify any relationship between ED o/c and 10-day inpatient mortality	34,377 patients (o/c shifts) 32,231 patients (non-o/c shifts)	In-hospital death recorded within 10 days of most recent ED presentation	Acceptable	ED patients presenting in times of o/c had significantly higher 10 day in-hospital mortality than those presenting to a non-o/c ED
Richardson / Australia / 2009 [97]	Retrospective cohort	To identify any relationship between access block and the time to definitive care of patients with fractured neck of femur.	369 cases of fractured neck of femur	Time to surgery (<24 hrs = 'timely') in relation to ED crowding as measured by access block occupancy (ABO) quartile	Acceptable	Significant relationship between ABO quartile at presentation and delayed surgery (p = 0.006)
Sikka / USA / 2010 [98]	Retrospective cohort	To measure the correlation between ED occupancy rate and time to antibiotic administration for patients with pneumonia	334 patients	Initial antibiotic administration within 4 hrs of ED arrival	Acceptable	Significant negative association between time to antibiotic treatment and ED crowding, as measured by ED occupancy rate
Singer / USA / 2011 [99]	Retrospective cohort	To explore the association between ED boarding and clinically important patient outcomes	41,256 admissions from the ED	In-hospital mortality	Acceptable	Prolonged ED boarding negatively associated with significant increase in in-hospital mortality and significant increase in IPLOS
Sprivulis / Australia / 2006 [100]	Retrospective cohort	To examine whether high hospital occupancy and ED access block are associated with increased inpatient mortality	62,495 hospital admissions	Deaths on days 2 ,7 and 30 evaluated against an overcrowding hazard scale	Acceptable	Hospital and ED o/c is associated with a 30% relative increase in mortality by Day 2 and Day 7 for patients requiring admission via ED to an inpatient bed
Sun / USA / 2013 [101]	Retrospective cohort	To assess the association of ED crowding with subsequent outcomes in a general population	995,379 ED visits resulting in admission to 187 hospitals	Inpatient mortality	Acceptable	High ED crowding associated with: 5% greater odds of inpatient death 0.8% increase in IPLOS
Tekwani / USA / 2013 [102]	Retrospective cohort and patient survey	To evaluate the impact of ED crowding on satisfaction of patients discharged from the ED	1,591 patient satisfaction scores over 497 8-hr shifts	Mean patient satisfactions scores Modified EDWIN score ED census Ambulance diversion rate	Low	ED crowding significantly associated with decreased patient satisfaction ($p < 0.001$)
Tsai / Taiwan / 2016 [103]	Retrospective cohort	To investigate the impact of crowding and number of ED staff on efficiency of ED care processes for patient with acute stroke presenting $\leq$ 3 hrs of symptom onset	1,142 acute stroke patients	Door-to-assessment time (DTA) Door-to-computed tomography completion time (DTCT) Door-to-needle (DTN) time where appropriate	Low	DTA and DTCT times significantly increased in times of crowding No effect on DTN time
van der Linden / Holland / 2016 [104]	Retrospective Chart review	To assess the impact of ED crowding on triage processes	45, 539 ED presentations	Target time to triage (mandated target time = 10 mins) Any triage score assigned	Acceptable	ED crowding associated with: significant delay in target time to triage significant number not assigned a triage score
Verelst / Belgium / 2015 [19]	Prospective observational	To determine whether ED crowding was independently associated with in-hospital death within 10 days of ED admission	32,866 admissions	Risk-adjusted HR for in-hospital death occurring within 10 days of ED admission in crowding quartile 4 vs. occupancy quartiles 1, 2 and 3	High	No significant association between ED crowding and overall risk of mortality

(*Continued*)

Table 2. (Continued)

Author/ Country /year	Design	Aim/s	Sample	Primary outcome measure/s	Level of evidence	Summary of findings
White / USA / 2013 [105]	Retrospective cohort	To investigate the effect of boarding hospital inpatients in the ED on LOS of patients discharged from the ED	179,840 discharged patients	Discharged patient LOS	Acceptable	As boarder burden increased, EDLOS for discharged patients increased by 10%
Wickham / Sweden / 2017 [106]	Retrospective cohort	To investigate the effect of crowding on EDLOS of ten most common medical or surgical complaints	19,200 ED visits 4,456 high acuity 14,744 low acuity	Median EDLOS for 10 chief complaints, stratified by high acuity (triage scores 1&2) and low acuity (triage scores 3–5)	Acceptable	Significant 46% increase in EDLOS for high acuity patients in times of crowding, true for all complaints except 'wound' Significant 82% increase in EDLOS for low acuity patients in times of crowding, true for all 10 conditions studied
Zhou / China / 2012 [107]	Retrospective cohort	To investigate whether patients boarded in the ED are subjected to increased serious complications	20,276 admitted patients	New onset of shock Need for intubation Death within 24 hrs of decision to admit	Acceptable	Positive correlation between high daily hospital occupancy and rates of shock and intubation, but not death within the initial 24 hrs post-admission request

*Papers also looked at causes of crowding

ABO = access block occupancy AMI = acute myocardial infarction AOR = adjusted odds ratio ATS = Australian triage scale BP = blood pressure CAP = community acquired pneumonia CCL = cardiac catheterisation laboratory CT = computerised tomography DIT = door-to-imaging time DTA = door-to-assessment time DTCT = door-to-computed-tomography time DTN = door-to-needle time ECG = electrocardiograph ED = emergency department EDLOS = emergency department length of stay EDWIN = Emergency Department Work Index HR = hazards ratio IPLOS = inpatient length of stay IVF = intravenous fluid NEDOCS = National Emergency Department Overcrowding Scale o/c = overcrowding/ed OR = odds ratio PCI = percutaneous coronary angiogram

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investigated the consequences of crowding reported negative effects. Similarly, all included studies evaluating potential solutions, with two exceptions [57, 58], reported significant improvements in measures of crowding, leading to questions about the potential for publication bias in this area of research. As regards the solution studies, in many cases it was not possible nor advisable to blind clinicians to the interventions. This makes them vulnerable to the Hawthorne effect, whereby an initiative improves outcomes as participants are aware that their practice is being observed and therefore modify their behaviour. However, for the majority of the interventions in this type of health services improvement research it could be unethical to undertake a blinded randomised control trial.

Consequences of ED crowding

Forty of the included studies examined the consequences of ED crowding, with three of these being prospective [18, 19, 81] (Table 2). Almost all were undertaken in single EDs and reported negative consequences associated with ED crowding. The included studies investigating the consequences of ED crowding can be broadly categorised into patient, staff or system level effects (Table 4).

Patient

Effects on patients included delays in being assessed and receiving required care [29, 30, 76–79, 81, 83, 84, 87, 90, 91, 93, 94, 97, 98, 103, 104], increased frequency of exposure to error [18], including medication errors [17], reduced patient satisfaction [102], increased inpatient length of stay (IPLOS) [82, 88, 95, 99, 101] and poorer outcomes [29, 30, 75, 92, 107]; the latter included increased inpatient mortality [3, 80, 85, 96, 99–101].

Table 3. Studies investigating potential causes of ED crowding (n = 14).

Author / Country /year	Design	Aim/s	Sample	Outcome measure/s	Level of evidence Quality assessment	Summary of findings
Aboagye-Sarfo / Australia / 2015 [108]	Population-based longitudinal study	To analyse recent trends and characteristics of ED presentations in Western Australia (WA)	All ED presentation in WA between 2007–2013	Annual number and rates of ED presentations	Acceptable	Key drivers of increased ED presentations (4.6% annually) were people with urgent and complex care needs
*__Bond / Canada / 2007__ [29]	Non-comparative survey study	To investigate the frequency, determinants and impacts of ED crowding	158 ED Directors	Frequency, determinants and impacts of ED crowding	Low	Access block EDLOS Increased complexity and acuity of patients Lack of access to primary care Non-urgent patients
*__Derlet / USA / 2002__ [30]	Non-comparative survey study	To determine the incidence, causes and effects of o/c in EDs in three US states	210 ED directors	Incident, causes and effects of ED o/c	Low	Access block Increased severity of conditions Increased ED volume
Cowling / UK / 2013 [109]	Cross-sectional, population based	To examine the association between access to primary care and ED visits	7,856 GP practices	Number of self-referred, discharged, ED visits by the registered population of a general practice	Acceptable	Significantly less self-referred, discharged, ED visits from practices that provided timely access
Dunn / Australia / 2003 [110]	Pre-post, retrospective, cohort	To determine if changes in hospital occupancy would affect ED occupancy and ED wait time performance	1,133 ED visits pre 2,332 ED visits post	Hospital occupancy Access block days EDLOS LWBS rate	Acceptable	Significant decrease in: Hospital occupancy Access block days EDLOS LWBS rate
^__Estey / Canada / 2003__ [31]	Exploratory field study	To describe the perceptions of health care professionals regarding service pressures that result in ED overcrowding	Seven focus groups representing all 7 EDs in the region. Groups consisted of ED physicians (8), ED managers (8), and other ED staff including nursing and allied health (42).		Low	Shortage of inpatient beds Change of role of ED as 'holding unit' for the rest of the healthcare system Shortage of nursing staff Limited access to diagnostic services Increased numbers of high-acuity, elderly patients
Fatovich / Australia / 2005 [111]	Retrospective data analysis	To systematically evaluate the relationship between access block, ED o/c, ambulance diversion and ED activity	259,580 ED attendances	Hrs on ambulance diversion Hrs of access block	Acceptable	Ambulance diversion and poor ED performance were related to poor inpatient flow, access block
Forster / Canada / 2003 [112]	Retrospective data analysis	To identify the effect of hospital occupancy on EDLOS for admitted patients and patient disposition	351,385 ED visits	EDLOS Rate of daily referral from ED to specialist admitting teams	Acceptable	EDLOS significantly associated with hospital occupancy No association between hospital occupancy and decision to admit
Kawano / Japan / 2014a [113]	Cross-sectional, single-centre	To assess and model associations between types of ED staff and ED crowding	27,970 ED visits	Proportion of patients with a clinically significant delay EDLOS	Low	No significant negative association between presence of junior residents and clinically significant delay ***Results of modelling***: Adding 1 junior resident increased EDLOS for all patients Extra senior resident reduced EDLOS for discharged patients Extra attending physician reduced EDLOS for all patients

(*Continued*)

Table 3. (Continued)

Author / Country /year	Design	Aim/s	Sample	Outcome measure/s	Level of evidence Quality assessment	Summary of findings
Kawano / Japan / 2014c [114]	Retrospective data analysis	To estimate the increase in EDLOS with the trend of an ageing society	15,840 ED visits	EDLOS	Acceptable	Increase in older patients vising the ED has a significant negative effect on ED o/c
Knapman / Canada / 2010 [115]	Retrospective, cohort	To assess the impact of aged patients (≥65) in the ED on ED crowding, wait times and patient flow for non-emergent patients	223 patients	Wait time to see a physician	Low	Strong relationship between aged patients in the ED and increased wait time for non-emergent patients
Lucas / USA / 2009 [116]	Retrospective, cohort	To determine the effect of hospital census variables on EDLOS	27,325 ED visits	EDLOS Daily ED volume Proportion of ED admissions Daily hospital census Daily census of critical care and cardiac telemetry units Daily number of scheduled surgeries	Low	Significant negative relationship between EDLOS and ICU census, cardiac telemetry census and percentage of ED patients admitted
Moineddin / Canada / 2011 [117]	Data modelling	To assess the factors resulting in increased demand for ED services in a Canadian province	53,353 respondents to a Canadian nationwide survey exploring (among other things) health system utilisation	Number of ED visits in a year	Acceptable	Access to a primary care provider significantly reduces the odds of an ED presentation for low-severity conditions (triage categories 4&5)
^van der Linden / Holland / 2017 [20]	Mixed method	To compare staff perceptions of causes of ED crowding in two EDs: one in Pakistan and one in The Netherlands	18 one-hour staff interviews 12 in Pakistan 6 in The Netherlands	Staff perceptions of causes and solutions to ED crowding	Low	Increase in elderly patients and patients with complex conditions Delays in triaging Wait time for diagnostic procedures Delays in decision to admit Access block

*Papers also looked at consequences of crowding

^Paper also looked at solutions to crowding

ATS = Australian triage scale CT = computerised tomography ED = emergency department EDLOS = emergency department length of stay GP = general practitioner ICU = = intensive care unit LAP = low-acuity presentation LWBS = left without being seen o/c = overcrowding/ed

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Delayed assessment and treatment. A significant delay in time to balloon inflation for patients experiencing an acute myocardial infarction and transferred to the cardiac catheterisation laboratory (CCL) from the ED during times of crowding, was identified in one American retrospective cohort study [81]. Similarly, delays in undergoing surgery for patients presenting to crowded EDs with a fractured neck of femur, were identified in one Australian study [97]. A number of studies investigated the effects of crowding on time to medication administration in the ED. Findings were predominantly adverse, with crowding associated with delays in time to receive analgesic [79, 87, 91, 93] and antibiotic therapy [76, 77, 89, 90, 98], as well as delays in patients receiving their usual prescribed or 'home' medications [83]. Two studies reported negative impacts of crowding on timely care for patients with acute stroke [94, 103]. One study reported significant delays in triage times, with a significant number of patients not assigned any triage score in times of crowding [104].

Table 4. Studies reporting consequences of ED crowding.

Patient Effects
Poor patient outcomes e.g. for patients with chest pain [29, 30, 75, 92, 107]
Increased mortality [3, 80, 85, 96, 99–101]
Delayed assessment and care [29, 30, 76–79, 81, 83, 84, 87, 89–91, 93, 94, 98, 103, 104], including surgery [97]
Increased IPLOS [82, 88, 95, 99, 101]
Risk of readmission [3, 74]
Reduced patient satisfaction [102]
Exposure to error [17, 18]
Staff Effects
Non-adherence to best practice guidelines [18, 75–79, 90, 91, 93, 94, 98, 103, 104]
Increased staff stress [29]
Increased violence towards staff [29, 86]
System Effects
Increased IPLOS [82, 88, 95, 99, 101]
Increased EDLOS [29, 84, 105, 106]

IPLOS = inpatient length of stay EDLOS = emergency department length of stay

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Exposure to error. One American prospective observational study identified an increased frequency of medication errors, including the administration of incorrect and contraindicated medications, during times of crowding [17]. As well as delays in receiving medication, three studies reported an association between crowding and total failure to administer required analgesics or antibiotics [87, 90, 91]. ED crowding was independently associated with increased rates of blood culture contamination in one Taiwanese study, with the rate of contamination strongly correlated with the degree of crowding [18].

Increased IPLOS. All of the five studies examining the relationship between ED crowding and IPLOS reported a positive association [82, 88, 95, 99, 101]. One Australian study compared the effect of access block on the IPLOS of 11,906 admitted patients, and reported a mean increased IPLOS of 0.8 days in patients who experienced access block [95]. Richardson's study highlighted that the access block effect on IPLOS was relatively independent of illness severity or diagnosis, but was greatest in patients admitted in the out-of-hours period [95]. Similarly, Sun and colleagues reported a 0.8% increase in IPLOS for patients admitted via an ED which was experiencing crowding, defined by this group as the top quartile of the daily number of ambulance diversion hours [101].

Increased inpatient mortality. Although the majority of papers investigating the effects of ED crowding on inpatient mortality reported that as crowding worsened mortality increased, three studies found no relationship [19, 75, 77]. Two of the studies were focussed on specific groups of patients, namely patients presenting with non-ST-segment-elevation myocardial infarction (non-STEMI) [75] and patients with severe sepsis [77]. The third study, undertaken in a tertiary teaching hospital in Belgium, was the only prospective study included in this review that specifically investigated inpatient mortality [19]. Verelst and colleagues measured the outcomes of 32,866 adult patients admitted via the ED over a two-year period. They divided crowding into four quartiles, based on the ratio of the total number of ED patients to the total number of treatment bays, with quartile four considered as ED crowding. After adjusting for severity of illness they reported no association between ED crowding and risk of inpatient mortality at 10 days [19].

Conversely, the seven retrospective studies that investigated the effect of ED crowding on inpatient mortality all reported that mortality increased as crowding worsened [3, 80, 85, 96, 99–101]. The varying results can be partially explained by differences in study designs, making it difficult to compare findings between studies. There were wide-ranging differences in

measures of crowding, with daily hours of ambulance diversion [101], boarding time for admitted patients [99], mean ED occupancy [96], EDLOS [3] and relative ED occupancy [80, 85] variously applied as proxy measures of crowding. Similarly, there were differences in study populations, with most studies including all adult admitted patients [96, 99–101]. However, one study included only critically ill admitted patients [80], another included admitted and discharged patients [85], and another study considered only the outcomes for patients discharged from the ED [3]. However, Verelst et al. justified their finding of no association between ED crowding and increased risk of inpatient mortality as being due to their large sample size, controlling for multiple confounders and their use of a validated measure of crowding, in this case ED occupancy rate [19].

Staff

Identified negative effects on staff included increased stress [29], increased exposure to violence [29, 86], and non-adherence to best practice guidelines during times of ED overcrowding [18, 75–79, 89–91, 93, 94, 98, 103, 104]. Arguably, the latter could also be positioned with consequences for patients, but here we use it in the context of staff being unable to properly undertake their roles during times of increased crowding.

Increased stress and violence. In a Canadian survey study of 158 ED directors, increased stress among nurses was the most commonly perceived major or serious impact of ED crowding [29]. Staff stress was identified by more participants as an issue than increased wait times or poor patient outcomes. Increased physician stress was also identified as being driven by crowding [29]. A significant association between ED crowding and violence towards staff was reported in one study involving a retrospective chart review [86]. Physical violence was the most frequently documented type, with violence directed towards staff the majority of the time [86].

Adherence to guidelines. Poor adherence to approved guidelines was reported to be a consequence of ED crowding in 13 studies [18, 75–79, 89–91, 93, 94, 98, 103]. Increased time to assessment of pain and/or delays in administration of analgesics were found to be positively associated with ED crowding in all four studies investigating this issue [78, 79, 91, 93]. Similarly, of six studies investigating the effects of crowding on time to antibiotic therapy initiation, five identified a positive association between delayed time to administration and ED crowding [76, 77, 89, 90, 98]. One American study, involving the analysis of data from a voluntary registry tracking guideline adherence, found that patients with non-STEMI who boarded for long periods of time in the ED were less likely to receive guideline-recommended therapies and were at higher risk for repeat MI [75].

System

System-level consequences identified were those that led to 'bottle-necks' in the system, namely increases in length of stay (LOS), both within the ED itself (EDLOS) [29, 84, 105, 106] and also for those patients admitted to the hospital (IPLOS) [82, 88, 95, 99, 101]. Again, these could also be viewed as consequences for patients.

Increased EDLOS. The three studies that investigated the impact of crowding on EDLOS reported that EDLOS increased with increased crowding. An American, multi-site, retrospective cohort study investigated the effect of crowding on the EDLOS of 226,534 ED presentations at four sites over 12 months [84]. McCarthy and colleagues reported that (i) the number of patients in the waiting room had the greatest impact on time spent in the waiting room, (ii) the number of boarders in the ED was the most consistent factor associated with delays in ED care and (iii) more positively, ED crowding had little effect on time to treatment [84]. While

studying only the outcomes in terms of EDLOS of discharged patients, White et al. reported a 10% increase in EDLOS for patients who presented during times of crowding, defined by this group as the top quartile of boarder burden [105]. One Swedish study reported significant increases in median EDLOS for both high and low acuity patients presenting with one of the ten principal medical or surgical complaints during times of crowding [106].

Increased IPLOS. As reported under patient effects previously, all of the studies examining the relationship between ED crowding and IPLOS reported a positive association [82, 88, 95, 99, 101]. It should be noted that in the literature this is generally taken to mean that ED crowding leads to increases in IPLOS; however, as is the case with all observational studies, this type of research can only identify an association between EDLOS and IPLOS rather than identifying with any certainty a causative relationship in either direction. For instance, long IPLOS could reduce the availability of beds for patients in ED waiting to be admitted, thereby worsening ED crowding. This limitation is identified in the majority, but not all, of the observational studies included in this review.

Causes of ED crowding

Fourteen included studies investigated potential causes of ED crowding. The majority were retrospective cohort or data analysis studies, with four qualitative explorations [20, 29–31], and two data modelling studies [113, 117] (Table 3). Using the conceptual model of ED crowding developed by Asplin et al. [7], which divides ED crowding into three interdependent components, the studies that focussed on the causes of crowding can be broadly categorised as identifying input, throughput or output causes (Table 5).

Input

Causes of crowding related to the input phase of the ED process suggested increases in types of presentations, including those with urgent and complex needs [20, 29–31, 108], low-acuity presentations (LAPs) [29, 117], and presentations by the elderly [20, 31, 114, 115], as the main drivers. Access to appropriate care outside of the ED was identified as an issue in four studies [29, 31, 109, 117].

Types of presentations. Increased complexity and acuity of patients were perceived to be a cause of ED crowding by 54% of respondents in one American survey study [29]. A similar finding was replicated in an interview study comparing perceived causes of crowding in the Netherlands and Pakistan [20]. Similarly, a 4.6% annual average increase in ED presentations

Table 5. Studies identifying causes of ED crowding.

Input
Presentations with more urgent and complex care needs [20, 29–31, 108]
Increase in presentations by the elderly [20, 31, 114, 115]
High volume of low-acuity presentations [29, 117]
Access to primary care [29, 109, 117]
Limited access to diagnostic services in community [31]
Throughput
ED nursing staff shortages [30, 31]
Presence of junior medical staff in ED [113]
Delays in receiving test results and delayed disposition decisions [20]
Output
Access block [20, 29–31, 110–112]
ICU and cardiac telemetry census [116]

ICU = Intensive Care Unit

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over a six-year period was attributed to increases in presentations of people with urgent and complex care needs, in a population-based longitudinal study in one Australian state [108]. Aboagye-Sarfo and colleagues reported significant increases in presentations allocated Australian Triage Score (ATS) 2 and 3 (high acuity), as well as increases in patients requiring admission, and found that a greater proportion of patients admitted over the six-year period were aged 65 years and older [108]. Increased ED presentations by the elderly, as a factor contributing to crowding was a finding of two Canadian studies, one a retrospective cohort study [115] and the other exploratory field work involving seven focus groups with key ED staff [31]. Likewise, a Japanese study that undertook a cross-sectional analysis of all adult ED presentations at one ED concluded that older people in the ED had a significant negative impact on ED crowding [114]. Kawano et al. reported that crowding worsened as the mean age of patients in the ED increased [114].

Conversely, two studies reported that increased presentations by patients with LAPs was a driver of ED crowding [29, 117]. One was the result of survey research with 158 ED directors [29], while the other was the result of statistical modelling undertaken using the results of a large number of surveys exploring Canadian health system utilisation [117]. Moineddin et al. reported that improved access to primary care could significantly reduce the odds of ED presentations for patients with LAPs [117].

Access to other forms of care. Poor access to primary care was identified as a cause of ED crowding in four studies [29, 31, 109, 117]. A large UK study that used a cross-sectional, population-based design to investigate whether timely access to GP care led to fewer self-referred ED visits, reported an association. The model developed by this group predicted 10.2% fewer self-referred ED visits for those GP practices ranked in the top quintile for access, with patients able to secure a GP appointment within two days less likely to self-refer to the ED with low acuity conditions [109]. Similarly, a Canadian study concluded that having access to a primary care provider had the potential to reduce non-urgent ED visits (patients allocated triage categories 4 or 5) by 40% [117].

Throughput. ED nursing staff shortages as a cause of ED crowding was highlighted in exploratory fieldwork undertaken with 158 ED directors in Canada [31], and in one American study that surveyed 210 ED directors [30]. Adding one junior doctor to a shift increased the EDLOS for discharged patients by one minute, while having no statistically significant effect on EDLOS for admitted patients, in one Japanese study that modelled the effect of additional staff on EDLOS [113]. One interview study that compared the views of ED staff in the Netherlands and Pakistan on causes of crowding identified delays in receiving laboratory test results and delays in patient disposition decisions as issues in both countries [20]. These low quality, predominantly opinion-based studies, were the only included publications to suggest a throughput cause for crowding.

Output

All studies that reported on output factors as a cause of ED crowding concluded that access block, that is, the inability to transfer a patient out of the ED to an inpatient bed once their ED treatment has been completed, was the major contributor [20, 29–31, 110–112, 116].

Access block. Two studies analysed both ED and inpatient datasets to understand the relationship between hospital occupancy, access block and ED crowding [111, 112]. The Canadian study reported a significant relationship between ED crowding and hospital occupancy, with a 10% increase in hospital occupancy leading to an 18 minute increase in average EDLOS [112]. The Australian group found a linear relationship between ED occupancy during periods of hospital access block and total ED occupancy, with a similar relationship noted between

access block and ambulance diversion and EDLOS, two other commonly used indicators of crowding [111]. An American multi-site, retrospective cohort study reported a significant positive relationship between mean EDLOS for both intensive care and telemetry bed census, but did not find a significant relationship between ED crowding and total hospital census [116]. Lucas et al. acknowledged that EDLOS is likely to be impacted by total hospital census in times of high occupancy (>90%) but as the majority of their study was undertaken on days of occupancy <90%, the study would have been unable to detect this association [116].

One small Australian study used a novel approach to investigate the effect of access block on crowding. A short period (13 days) of industrial action led to the cancellation of all elective surgery and therefore to significant improvements in bed availability for ED admitted patients [110]. Dunn compared ED performance during the time of increased bed access with a 13-day period prior to and a 13-day period after the industrial action. When there was no elective surgery and an associated reduction in hospital occupancy, there were significant reductions in access block days, EDLOS for patients allocated triage categories 2–5 (ATS 1 excluded from analysis), and patients who did not wait for treatment [110]. Similarly, results of survey research with ED directors [29, 30] and multi-site, focus group research with key ED staff [31], highlighted lack of inpatient bed availability as one of the main perceived causes of ED crowding.

Solutions to ED crowding

Fifty-two of the included studies trialled, modelled or suggested potential solutions to ED crowding. The majority were retrospective, with four RCTs [25–28], one statistical modelling [64], and four prospective interventional studies [21–23, 38] (Table 1). Again, Asplin's [7] conceptual model can be used to categorise the studies that investigated potential solutions to crowding in the ED (Table 6).

Table 6. Studied and suggested solutions to ED crowding.

Input
GP-led walk-in centres / Co-located GP [32, 33, 64]
Extended GP opening hours [37, 43, 58, 72]
Choice of ED [64]
Social interventions including; education campaigns, financial disincentives, redirection [32]
Throughput
Split ESI 3 on presentation [34]
Earlier physician assessment [21, 23, 38, 50, 63, 65, 67, 71], including physician-led/supported triage [25, 40, 45, 47, 56, 60]
Fast-track / flexible care area [42, 55, 56]
Shorter turnaround-times for laboratory tests [26, 27, 52, 53, 66]
ED nurse flow coordinator [35, 44, 69]
Bedside registration [56, 68]
Nurse initiated protocols [28]
Earlier inpatient consultation [49]
Increased ED bed numbers [57, 69]
Increased ED staff [69]
Output
Active bed management [20, 36, 39, 46]
Leadership program/Support [39, 61, 67]
Implementation of nationally mandated, timed patient disposition targets [48, 54, 59, 62, 67, 69]
ED staff direct admit rights [63, 67]
Admitting team prioritise ED admissions [67]
Alternative admission policies [22, 41, 69, 70, 73]
Increased inpatient beds and staff [69]

GP = general practitioner ESI = Emergency Severity Index

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Input

Input factors focused on improved access to other forms of care, such as GP-led walk-in centres (WIC) [32, 33], a co-located GP within or near EDs [64], extended GP opening hours [37, 43, 58, 72] or providing a choice of ED [64]. Results of a number of social interventions were trialled over a 12 year period in one study from Singapore [32].

Co-located GPs and walk-in centres. The effect of a co-located GP on duration of wait for triage category 2 (high acuity) patients in the ED was modelled in one Australian study [64]. Sharma and Inder reported a 19% lower wait time for category 2 patients in EDs with a co-located GP, when compared to EDs without a GP [64]. The impact of a GP-led WIC on demand for ED care was the focus of one UK study [33]. This group used linear modelling to estimate the effect of the WIC on daytime GP-type attendances to other urgent care services in the area. A significant reduction of 8.3% in GP-type presentations to adult EDs was reported [33]. Opening of a WIC in Singapore was found to have no effect on ED presentations as the authors reported that the WICs attracted their own clientele who were unlikely to have attended the ED [32].

Increased GP opening hours. Another UK group evaluated the impact of a pilot 7-day opening of GP practices in central London [43]. Their analysis highlighted a significant, 17.9% reduction in weekend ED attendances by patients registered with practices involved in the pilot program. Dolton and Pathania also reported both a 19% fall in admissions among the elderly and a 29% reduction in elderly cases arriving by ambulance [43]. Similarly, another UK study that investigated the effect of later opening hours and 7-day opening of GP practices reported a 26% relative reduction in patients registered with the intervention practices self-referring to EDs with minor problems [72]. The opening of an after-hours (AH) GP located in a large regional Australian town, serviced by one ED and with limited AH services, resulted in a significant 8.2% daily decrease in total ED presentations of patients allocated ATS 4 and 5 (low acuity) [37]. Buckley et al. also reported an unexplained increase in ED presentations of those allocated ATS 1–3 (high acuity), of 1.36 per day, but that the opening of the AH service led to a 'gradual permanent change' in ED presentations [37].

Conversely, another Australian study that modelled the effect of AHs GPs on LAPs to six EDs in Perth, Western Australia, concluded that providing AHs GP LAP services was unlikely to reduce ED attendance, as LAPs were an 'inexpensive but constant part of ED workload' [58].

Social interventions. A study that reported on a number of social intervention trialled in Singapore over a 12 –year period reported mixed results. Public education campaigns were found to be effective initially but presentations reverted to pre-campaign levels some months after the end of each campaign [32]. Implementation of financial disincentives for non-emergency presentations began to reduce presentations once the fee exceeded the fees charged by primary health care clinics [32]. Redirection of non-emergencies to alternate facilities was successful initially, but was discontinued due to adverse public relations incidents [32].

Throughput

The majority of studies (60%) that reported on potential solutions to ED crowding focussed on expediting patients' throughput within the ED. These potential solutions mainly concentrated on 'front-ending' care earlier in the patient journey by providing earlier physician assessment [21, 23, 38, 50, 63, 65, 67, 71], including physician-led triage [25, 40, 45, 47, 60]. Dividing patients by level of acuity on arrival has also been successful in increasing throughput times, whether by opening a fact-track or flexible care area for lower acuity presenters [42, 55], or dividing patients within the same triage code [34]. Other throughput interventions included

reducing the turnaround-time of laboratory tests [26, 27, 52, 53, 66], the introduction of an ED nurse flow coordinator [35, 44, 69], increasing medical and nursing staff numbers in the ED [69], bedside registration immediately following triage [68], nurse initiated protocols [28], strategies to ensure earlier review by admitting teams [49] and increasing bed numbers in the ED [57, 69].

Early physician assessment. Eight included papers investigated the effects of early physician assessment on measures of ED crowding [21, 23, 38, 50, 63, 65, 67, 71]. Seven of these studies reported significant decreases in EDLOS [21, 23, 38, 63, 65, 67, 71], while four reported significant decreases in numbers of patients who either LWBS or DNW [23, 38, 67, 71]. One Australian group introduced a suite of interventions to improve throughput and output within their large tertiary ED, which had previously been named as the worst preforming ED in Australia in terms of its NEAT '4-hour-rule' compliance [67]. Sullivan et al. also reported significant reductions in inpatient mortality rates between baseline and the post-reform period.

Conversely, when one Dutch urban ED initiated Medical Team Evaluation as a means of improving 'front-end operations' through a host of initiatives, including team triage and a quick registration process, results showed a significant increase in EDLOS for patients in triage categories 2–4, regardless of discharge destination [50]. Lauks and colleagues attributed this rise to the increase in orders for diagnostic radiology during the intervention period [50].

Five groups investigated the effect of a physician in triage (PIT) model on common ED crowding metrics [25, 40, 45, 47, 60]. Although the interventions were slightly different, all involved a senior physician triaging patients early in their arrival to the ED. All reported a significant reduction in EDLOS post implementation; however, one found this decrease to apply only for patients who were subsequently discharged [45]. Han and colleagues did report an increase in boarding time for admitted patients during the intervention period, a potential reason for the intervention having little effect on EDLOS for admitted patients [45]. Only one study reported a significant decrease in patients who left without being seen [40], and two studies reported significant reductions in the number of hours on ambulance bypass during the intervention period [45, 47]. Significant decreases in both 7-day and 30-day mortality post ED visit were also reported by Burström et al. after the introduction of a PIT scheme [40].

Fast-track and flexible-care areas. Fast-track [42] or use of a flexible-care area [55] to improve flow within the ED were reported in two papers. Both of these studies reported significant reductions in EDLOS for triage category 4 (low acuity) patients only. As the majority of patients diverted to these areas were triaged as category 4, it is not surprising that the intervention had the greatest effect in this patient group. The fast-track group also reported significant improvements in meeting national standards for wait times for patients triaged as category 4 [42]. Similarly, an American group that geographically separated triage category 3 patients with low variability (that is, with conditions likely to follow a standardised work flow), in order to fast-track these patients through the department, reported significant decreases in EDLOS for all category 3 and 4 discharged patients [34]. Arya and colleagues attributed the decreased LOS for higher variability category 3 patients to the decreased throughput of patients through the urgent area of the ED, thereby reducing the workload of staff in this area [34].

Reducing laboratory test turnaround-times. Reducing the time taken to turnaround laboratory tests as a means of reducing EDLOS was investigated in four studies. Three studies reported on the use of point-of-care testing (POCT) in the ED versus central laboratory pathology testing [26, 52, 53], while one employed dedicated laboratory technicians within the central laboratory who were available 24/7 to undertake all laboratory testing for the ED [66]. All four studies reported significant reductions in EDLOS attributed to the interventions, although one noted that the reduction in EDLOS was only significant if patients had all three

available tests performed [52]. One American group undertook a RCT to assess the impact of earlier initiation of diagnostic tests whilst triage category 3 patients with abdominal pain were in the waiting room [27]. Begaz and colleagues reported a significant 44 minute reduced mean EDLOS for patients randomised to the intervention versus the control arm of the trial [27].

ED nurse flow coordinator. The introduction of a senior nurse (emergency journey coordinator), focussed on identifying and resolving delays for patients who had been in the ED for 2–3 hours, led to a 4.9% significant increase in the number of patients meeting NEAT targets in one Australian ED [35]. Similarly, a nurse navigator role trialled as part of a non-RCT reported significant increases in the proportion of patients meeting NEAT time and reductions in mean EDLOS during days when the trial was operational [44]. A NZ group, who investigated the impact of nationally mandated times for patient disposition at four hospitals, reported the introduction of nurse flow coordinators at all four institutions as one of many interventions introduced to successfully reduce crowding [69].

Other. Bedside registration immediately following triage, occurring concurrently with physician evaluation, resulted in a significant decrease in time from triage to treatment room allocation for non-urgent patients, in one American before-after intervention study [68]. However, after an initial significant reduction in room-to-disposition time, this improvement was not sustained to 12 months after the intervention [68]. Three of six nurse-initiated protocols were reported to significantly reduce mean EDLOS in one American study [28]. A Korean study that used short text message reminders when ED patients waited more than two and more than four hours for inpatient consultations resulted in a significant 36 minute reduction in median EDLOS for admitted patients [49]. The expansion of the ED from 33 to 53 beds, with no changes to staffing ratios, resulted in a significant 20 hours per day increase in ED boarding in one American study [57]. Conversely, in one NZ study, provision of extra ED beds in three out of the four hospitals studied, as well as the provision of additional ED nursing and medical staff, resulted in a decreased median EDLOS [69].

Output

Solutions looking at output factors exclusively focused on getting admitted patients out of the ED in a timely manner once their ED assessment and treatment was complete, that is, reducing access block. Suggested and trialled strategies included more active bed management [20, 36, 39, 46], leadership support to expedite hospital admissions from the ED [24, 39, 69] including leadership programs [61, 67], and implementation of nationally mandated timed disposition targets [48, 59, 62, 67, 69], which have included; giving ED staff admitting rights [63, 67], ensuring admitting teams prioritise patients waiting in the ED during times of high ED census [67], and increasing inpatient bed capacity [69]. Alternative admission units, including an ED-managed, acute care unit [22] and flexible acute admission units [51, 69, 70], have also been trialled. Implementation of an independent or full capacity program to provide alternative options for admission in times of crowding has been trialled in two studies [41, 73].

Bed management. An active bed management strategy to alleviate ED crowding was evaluated by one American study [46]. The initiative resulted in a 98 minute average reduction in EDLOS for admitted patients, as well as a reduction in the number of hours the hospital was on alert, in this case limiting the types of patients that could be transported by ambulance to the ED [46]. The intervention strategy involved introducing a bed manager who assessed bed availability in real time and who could triage and admit patients to inpatient beds, and a bed director who could call on other resources, including extra staff or admitting medical patients to non-medical beds, to avoid the hospital being put on alert [46]. Similarly, an intervention that included the implementation of a position to ensure timely identification and allocation

of beds, coupled with improved communication and education for staff around a new bed management strategy, resulted in a mean 21% decrease in EDLOS for admitted patients, and a 52% reduction in mean boarding time in one American ED [36]. When ED patients were given priority over inpatient beds, as one of a number of quality improvement initiatives to reduce crowding in one American study, there was a significant reduction in median time from bed assignment to disposition and significant reductions in median EDLOS [39].

Leadership programs and leadership support. One American hospital convened hospital leaders and ED staff to work collaboratively to expedite hospital admissions from the ED [61]. This group introduced a computerised tracking system to ensure the ability for real time tracking of ED admit wait times. The group agreed to measurable goals in terms of the time between the decision to admit and final transfer to an inpatient bed. Patel and colleagues reported a significant 16% increase in patients transferred to an inpatient bed within 60 minutes of the decision to admit [61]. The group also reported significant decreases in boarding time, patients who LWBS and hours of ambulance diversion [61]. An Australian group also convened a taskforce with senior executive sponsorship to provide oversight and direction for initiatives to improve hospital admission targets [67]. Results of this initiative have been discussed under throughput solutions above and access targets, below. An American study that endeavoured to identify the different strategies used by high preforming, low preforming and improving hospitals, in relation to their levels of ED crowding found that no specific interventions were related to performance level [24]. They did, however, report that four organisational domains were associated with high preforming hospitals, one of which was executive leadership involvement [24]. Tenbensel and colleagues reported that leadership involvement in influencing cultural change was a key factor in implementing hospital-wide initiatives to meet mandated, timed admission targets in NZ [69].

Introduction of nationally mandated, timed, patient disposition targets. Six studies have recently reported on the effect of timed patient disposition targets on commonly reported ED crowding measures [48, 54, 59, 62, 67, 69]. One Australian study reported hospital-wide education to increase awareness of NEAT in the six months prior to its implementation as the only intervention [62]. Perera et al. reported a significant increase in the number of patients leaving the ED within the guideline recommended 4-hours, post-NEAT implementation, which was sustained in their second evaluation period, one-year post-implementation [62]. A significant reduction in access block was also reported. However, this group also found a significant increase in IPLOS and in the numbers of inter-unit transfers within 48 hours of admission. They attributed this to the possibility of 'rushed referrals' by ED staff in an effort to meet NEAT targets [62].

Conversely, Sullivan et al. report on a plethora of reforms introduced at their large, tertiary referral hospital [67]. These included reforms both within the ED itself, as well as hospital-wide interventions. Many of these initiatives were aimed at reducing access block in the ED, such as: ED staff able to organise direct admission for stable patients, clear limits on response times to ED referrals by inpatient teams, and improved processes for timely discharge of inpatients [67]. As discussed under throughput solutions above, this group reported significant decreases in EDLOS and inpatient mortality [67]. The only negative outcome reported by this group was a small, but statistically significant, increase in re-presentations to the ED within 48 hours, which was seen by the researchers to be clinically insignificant [67].

Ngo and colleagues reported on a longitudinal analysis of the effect of NEAT on five hospitals in Western Australia, without giving the specifics of interventions introduced at each hospital prior to NEAT implementation [59]. Similar to the above studies, they reported significant reductions in percentage of access block hours in all five hospitals and significant decreases in median EDLOS, primarily for high acuity (ATS 1–3) patients, at three out of the

five hospitals [59]. The UK study did not give the specifics of interventions but stated that a whole-system approach was expected to be adopted to achieve the target [54]. Mason et al. reported a 29% reduction in the proportion of patients who remained in the ED after four hours as well as a 25% reduction in unadjusted median EDLOS for admitted patients [54].

The NZ studies also reported reductions in median EDLOS post target implementation [48, 69]. One study reported on the outcomes in relation to when they had the biggest impact and their success in relation to the increased use of short-stay units (SSU) [69]. Tenbensel and colleagues found that after an initial reduction in total EDLOS (time in ED plus time in SSU), this reduction slowed in later years, indicating an increased reliance on the use of SSUs to meet target disposition times [69]. Their interview data indicated that transfer to a SSU was sometimes initiated without clinical justification in an effort to meet targets. Nevertheless, they acknowledged that from a patient perspective, time in the SSU is preferable to a longer EDLOS [69]. Jones et al. determined *a priori* quantitative changes that were deemed to be of clinical importance, regardless of statistical significance [48]. They reported clinically significant reductions in median IPLOS, median EDLOS, and access block hours [48]. Although there was no change in 2-day ED representations, they did report a clinically significant 1% increase in 30-day readmissions. Similar to Tenbensel and colleagues [69], Jones et al. reported an increase in use of SSUs, with $<$ 5% of ED admissions to SSUs in 2009 (pre implementation) versus almost 13% in 2012 [48]. However, the latter study found statistically and clinically significant reductions in total EDLOS, which was greatest for admitted patients, indicating that the SSUs were not merely used to 'stop the clock'.

Alternative admission policies. One American study explored the impact of a 14-bed monitored inpatient unit, staffed by the ED, on ED crowding [22]. Kelen and colleagues reported significant decreases in both rates of LWBS and hours of ambulance diversion [22]. Similarly, a Taiwanese study reported significant reductions in mean EDLOS for admitted patients after the introduction of a 14-bedded 'high turnover' unit, specifically used for ED admissions [51]. Utilising empty beds throughout the hospital in the out-of-hours period to accommodate non-specialist admissions to reduce EDLOS and avoid the need for inter-hospital transfers was trialled in one Dutch hospital [70]. The group reported no change in the EDLOS for patients eligible for admission to the new model, at a time when EDLOS for other patients increased significantly [70]. Providing the ED with extra assistance from hospital leaders and specialists during times of crowding in order to expedite patient disposition from the ED has been reported in two studies (capacity protocols) [41, 73]. The Korean study, which was investigating the long-term effects of the protocol, as it had been in place for six years, reported significant reductions in EDLOS [41]. Conversely, the American study, which reported on the effect of a relatively new intervention, reported a significant 34 minute increase in EDLOS on days when the full capacity protocol was operational [73]. They also reported a 92% significant decrease in hours of ambulance diversion related to the intervention [73].

Discussion

Consequences of crowding

A key finding of this review is that the consequences of ED crowding are well established. Reported consequences can be categorised as affecting patients, staff and the healthcare system, with some overlap. Some of the negative effects of crowding identified, such as adverse outcomes for patients, including treatment delays and increased mortality, were similar to those identified in Hoot's review [8]. However, the previous review identified provider losses as a potential negative effect [8], a finding that was not replicated in the current review.

Similarly, Hoot et al. reported impaired access to ED care, as measured by rates of LWBS and ambulance bypass, as potential consequences [8], whereas both of these measures were used as indicators of crowding in the current study.

The quality of the studies investigating consequences of crowding were variable, with only one high quality, prospective study included [19]. This was also the only study that did not find a link between crowding and the primary outcome measure, in this case increased inpatient mortality [19]. It did appear that the authors of some of the lower quality studies were determined to prove a negative consequence between ED crowding and their outcome of interest. For example, Kulstad and Kelly [81] concluded that crowding decreased the likelihood of timely treatment for acute myocardial infarction (AMI), when their study showed no relationship between crowding and time to first electrocardiogram or time to arrival in the cardiac catheterisation laboratory (CCL), which are the time stamps that ED staff have most influence over. Their study found a relationship between crowding and time to balloon inflation in the CCL, a delay that is presumably outside of the control of the ED [81].

Similarly, Hwang and colleagues [78] concluded that crowding is significantly associated with poorer pain management. Their study identified a negative association between crowding and time to assessment and documentation of pain, but no relationship to time to analgesic administration, that is, the outcome that affects patient care [78]. Rather than identifying negative outcomes for patients who present to crowded EDs, both of these studies could be taken to show the opposite. That is, that even when the ED is under stress, patients identified as having urgent clinical needs, such as those suffering from an AMI or being in severe pain, still receive appropriate, timely care. We acknowledge that the complexity of health services research provides challenges in terms of research design, often influencing investigators decisions' to measure outcomes for which data is easily accessible. However, care needs to be taken when designing studies and interpreting results to ensure reported outcomes are robust and reflect the most appropriate measure of the phenomena under study.

Solutions to crowding

Trialled and modelled solutions to ED crowding included providing alternative options to the ED for patient care, moving patients through the ED more quickly and expediting patients' exit from the ED on completion of care. Many of these solutions were identified in the previous review [8], particularly the solutions aimed at resolving access block and providing alternative admission options. However, Hoot's review identified many demand management strategies, including diverting patients to other forms of care and focussing on frequent visitors, which was the focus of only one, older study included in this review [32]. The demand management and patient diversion papers in the earlier review were all published more than twelve years ago, perhaps indicating the lack of long-term success of these initiatives at reducing ED crowding.

All studies included in this review evaluating solutions, with two exceptions [57, 58] reported significant improvements in measures of crowding related to the intervention, whether trialled or modelled. It should be noted that in Nagree's study [58], that concluded that AHs GPs would have little impact on LAPs to EDs, the Sprivulis method [118] was used to calculate LAPs. This method consistently estimates a lower proportion of presentations as 'GP-type' than other methods [119, 120]. One Australian group reported a range of 15–69% of ED attendees as 'GP-type', depending on which of four definitions were used to calculate the proportion [119], with the Sprivulis method [118] producing the lowest percentage. Another Australian group [37] speculated that their finding of reduced LAPs to the ED following the opening of an AHs GP differed from Nagree's findings because of the relative rural nature and

therefore, lack of alternative options in the study locality, compared to the urban area studied by Nagree [58]. This finding is a clear indicator that a 'one size fits all' model to alleviate crowding is unlikely to be successful, as the causes of crowding are contextually specific to the environment in which the crowding occurs, and therefore requires solutions explicitly designed for that environment. The above also highlights the difficulties in comparing research outcomes when non-standardised definitions are employed as study outcome measures. This issue has been highlighted before [12, 13], with calls for a consensus on definitions for crowding, 'GP-type' presentations and LAPs to enable more accurate measuring and reporting of these issues.

Quality of solutions studies. The quality of the evidence evaluating solutions to ED crowding was higher than for the other two areas (causes and consequences) with 60% of the studies assessed as providing high or acceptable levels of evidence. Many input, throughput and output solutions, including WICs, providing earlier physician assessment on arrival to the ED, and providing alternative admission options during times of inpatient access block, have been found to have promising results. While POCT was trialled in five included studies, only two of these, both RCTs [26, 27], were assessed as providing high levels of evidence, suggesting more research needs to be undertaken in this area.

While the majority of the included papers, particularly those that looked at throughput initiatives, did not measure unintended 'upstream' effects of the interventions to reduce crowding, a number of the more recent 'target' papers did [48, 54, 62, 67]. The Australian papers reported increased in-hospital transfers, increased IPLOS [62], and a small clinically insignificant increase in ED representations within 48 hrs [67] as potentially negative clinical outcomes post-NEAT implementation. One NZ study reported a clinically important 1% increase in readmissions within 30 days [48]. The UK study found an unexpected increase in time to be seen by a clinician and reported that when EDLOS was adjusted for clustering by hospital, there was an increase in total time in the ED for admitted patients [54]. Overall, the 'target' studies provided acceptable levels of evidence of both improved processes and patient outcomes following their introduction, indicating that more research into the specific interventions undertaken to achieve targets, with an emphasis on understanding what worked, where and why, could go some way towards addressing ED crowding. Similarly, more recent studies have highlighted the positive effects of undertaking a whole-of-system approach, including involvement of system leaders and using available data for more effective communication as important strategies to reduce crowding [24, 67, 69].

Although one of the NZ 'target' studies [69] acknowledged some input strategies were implemented in at least one of their test sites, in the main 'target' studies focussed their reporting on throughput and output initiatives to address crowding. The two UK studies that reported reduced ED presentations following 7-day opening of GPs [43, 72], as well as the successes achieved after the opening of an AH GP clinic in a large regional centre [37], provide evidence to support further trials of increased access to primary care as a potential solution to crowding in areas where increased input has been identified as a causative factor.

Costs of solutions. A number of studies identified financial costs associated with the interventions [35, 43, 53, 69, 72], but did not provide any cost benefit analysis. One exception is an Australian study that calculated a $2,121 AUD per day saving to the ED after the introduction of a nurse navigator role [44]. Similarly, although not providing a comprehensive cost benefit analysis, Nagree et al. estimated that LAPs accounted for only 2.5% of total ED costs in the Perth metropolitan area, and therefore AH GPs were not a worthwhile investment if their aim was to reduce LAPs to the ED in a metropolitan setting [58]. Whittaker et al. acknowledged that while extended GP opening hours was seen to reduce patient-initiated ED referrals, extended opening hours may not produce a cost saving to the healthcare system [72].

Causes of crowding

Surprisingly, the least number of studies included in this review investigated the causes of ED crowding. Causes included increases in types of ED presentations, limited access to primary care and access block for patients requiring admission. Access block, inadequate staffing and LAPs were also identified in Hoot's [8] review as causes of crowding. However, a notable new identified cause in this review is the increase in presentations by patients with complex and chronic conditions, including the elderly, as a driver of ED crowding [29, 108, 114, 115]. This finding may indicate the emergence of a new driver of crowding, namely the elderly with multiple chronic conditions, and merits further investigation. The quality of the evidence investigating causes was mixed, with only seven (50%) studies assessed as being of acceptable quality, while the remainder were scored as low. Three of the higher quality studies identified access block as having a negative impact on ED crowding; however, all of these studies are more than ten years old [110–112]. The remaining four studies identified increased presentations by patients with chronic and complex care needs, including the elderly, and limited access to GPs, as causative factors of crowding [108, 109, 114, 117], adding further weight to the suggestion that increasing access to primary care may help to reduce crowding.

Fifteen years ago, Asplin [7] proposed in his conceptual model, that ED crowding could be partitioned into three interdependent components, input, throughput and output. Of the 14 studies that investigated the causes of ED crowding, only four identified a throughput issue, namely experience level of staff [113], shortages of staff within the ED [30, 31], and delays in test results and disposition decisions [20] as potential causative factors. However, of the 52 papers that trialled or modelled potential solutions to crowding, 31 (60%) involved improving patient throughput as a means of resolving the issue, with none of the interventions specifically targeted at improving staffing issues. This suggests a mismatch between the proven or accepted causes of crowding and the solutions developed and implemented to address the problem. There is general agreement that many of the causes and therefore solutions to crowding lie outside of the ED. However, our findings suggest that, as the most immediate effects of crowding are visible in the ED, ED clinicians have perhaps taken it upon themselves to change what they can influence to try to ameliorate the problem.

This review identified many new studies focussed on the ED crowding agenda. However, there is a paucity of research aimed at identifying the specific, contextual factors causing the phenomenon, with only eight new studies aimed at identifying causes published in the last ten years. The imbalance between the vast number of studies investigating the consequences and trialling solutions to ED crowding, versus the scarcity of studies aimed at identifying the causes, warrants attention. As stated by Asplin et al., 'the development of valid and reliable measures of the factors **contributing** to ED crowding is the **first step** in developing a coherent research and policy agenda' [7]. It appears that 15 years after this recommendation the ED research community is yet to thoroughly address that 'first step'.

Limitations

The literature search was limited to research published in English and in peer-reviewed journals. Potentially, a wider search strategy may have located a greater number of relevant studies; however, with the number of studies appraised and included, we feel this review provides a comprehensive analysis of the current research on ED crowding. Only seven of the included studies were assessed as being of high quality. This is an issue that has been highlighted before, with authors also acknowledging that it is difficult to critique complex and multi-faceted health service research using evaluation criteria designed for drug trials [121]. However, we elected to assess the quality of the evidence using traditionally accepted methods to enable the

comparability of our results with previously published reviews. When allocating causes and solutions studies as related to either input, throughput or output, every effort was made to follow the original intentions of the study authors; however, this intention was not always clear.

Conclusion

There is an abundance of research illustrating the negative consequences of ED crowding for patients, staff and the healthcare system. While many solutions have been trialled and modelled, with varying levels of success, there is a mismatch between the identified causes of crowding and the initiatives implemented in efforts to resolve the problem. More recent studies investigating the effects of timed disposition targets and extending GP opening hours have provided some promising results and warrant further investigation and evaluation, with a particular focus on which interventions worked in which contexts, relative to identified local causes of crowding. A significant finding of this review is the growing body of evidence suggesting elderly patients with complex, multi-morbid conditions represent an increasingly important driver of ED crowding. This review has highlighted the need for further, high quality research into the specific, contextual issues that lead to ED crowding and the tailoring of evidence-based solutions to address identified causes. There is agreement that the problem and therefore the solutions to ED crowding lie largely outside of the ED. Therefore, it is imperative that the whole of the system, including patients, are involved in identifying both the causes of and acceptable, sustainable solutions to ED crowding.

Supporting information

S1 Table. PRISMA checklist.
(PDF)

S1 File. Details of search strategy.
(PDF)

S2 File. Study protocol.
(PDF)

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References

1. Pines JM, Griffey RT. What we have learned from a decade of ED crowding research? Acad Emerg Med. 2015; 22(8):985–7. https://doi.org/10.1111/acem.12716 PMID: 26194441
2. Plunkett PK. Blocked, bothered and bewildered am I. Eur J Emerg Med. 2006; 13(2):65–6. https://doi.org/10.1097/01.mej.0000209056.08752.41 PMID: 16525230

3. Guttmann A, Schull MJ, Vermeulen MJ, Stukel TA. Association between waiting times and short term mortality and hospital admission after departure from emergency department: population based cohort study from Ontario, Canada. BMJ. 2011; 342:d2983. https://doi.org/10.1136/bmj.d2983 PMID: 21632665
4. Dinh MM, Bein KJ, Latt M, Chalkley D, Muscatello D. Age before acuity: the drivers of demand for emergency department services in the greater Sydney area. Emerg Med J. 2015; 32(9):708–11. https://doi.org/10.1136/emermed-2014-204174 PMID: 25532104
5. Morley C, Stankovich J, Peterson G, Kinsman L. Planning for the future: emergency department presentation patterns in Tasmania, Australia. Int Emerg Nurs. 2018; 38:34–40. (Published online Sept 2017). https://doi.org/10.1016/j.ienj.2017.09.001 PMID: 28958418
6. Lowthian JA, Curtis AJ, Jolley DJ, Stoelwinder JU, McNeil JJ, Cameron PA. Demand at the emergency department front door: 10-year trends in presentations. Med J Aust. 2012; 196(2):128–32. https://doi.org/10.5694/mja11.10955
7. Asplin BR, Magid DJ, Rhodes KV, Solberg LI, Lurie N, Camargo CA Jr. A conceptual model of emergency department crowding. Ann Emerg Med. 2003; 42(2):173–80. https://doi.org/10.1067/mem.2003.302 PMID: 12883504
8. Hoot NR, Aronsky D. Systematic review of emergency department crowding: causes, effects, and solutions. Ann Emerg Med. 2008; 52(2):126–36. https://doi.org/10.1016/j.annemergmed.2008.03.014 PMID: 18433933
9. LaCalle E, Rabin E. Frequent users of emergency departments: the myths, the data, and the policy implications. Ann Emerg Med. 2010; 56(1):42–8. https://doi.org/10.1016/j.annemergmed.2010.01.032 PMID: 20346540
10. Richardson DB, Mountain D. Myths versus facts in emergency department overcrowding and hospital access block. Med J Aust. 2009; 190(7):369–74. PMID: 19351311
11. Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. BMJ. 2009; 339:b2535. https://doi.org/10.1136/bmj.b2535 PMID: 19622551
12. Jones P, Wells S, Ameratunga S. Towards a best measure of emergency department crowding: lessons from current Australasian practice. Emerg Med Australas. 2017. https://doi.org/10.1111/1742-6723.12868 PMID: 28941074
13. Hwang U, McCarthy ML, Aronsky D, Asplin B, Crane PW, Craven CK, et al. Measures of crowding in the emergency department: a systematic review. Acad Emerg Med. 2011; 18(5):527–38. https://doi.org/10.1111/j.1553-2712.2011.01054.x PMID: 21569171
14. Shenoi RP, Ma L, Jones J, Frost M, Seo M, Begley CE. Ambulance diversion as a proxy for emergency department crowding: the effect on pediatric mortality in a metropolitan area. Acad Emerg Med. 2009; 16(2):116–23. https://doi.org/10.1111/j.1553-2712.2008.00317.x PMID: 19076102
15. Critical Apprasial Tools / Checklists [Internet]. 2012 [cited August 2016]. Available from: http://www.sign.ac.uk/checklists-and-notes.html.
16. Morley C, Unwin M, Peterson G, Stankovick J, Kinsman L. The consequences and causes of, or solutions to, emergency department crowding: a systematic review protocol. PROSPERO 2017 CRD42017073439 2017 [Available from: https://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42017073439.
17. Kulstad EB, Sikka R, Sweis RT, Kelley KM, Rzechula KH. ED overcrowding is associated with an increased frequency of medication errors. Am J Emerg Med. 2010; 28(3):304–9. https://doi.org/10.1016/j.ajem.2008.12.014 PMID: 20223387
18. Lee CC, Lee NY, Chuang MC, Chen PL, Chang CM, Ko WC. The impact of overcrowding on the bacterial contamination of blood cultures in the ED. Am J Emerg Med. 2012; 30(6):839–45. https://doi.org/10.1016/j.ajem.2011.05.026 PMID: 22169577
19. Verelst S, Wouters P, Gillet J-B, Van den Berghe G. Emergency department crowding in relation to in-hospital adverse medical events: a large prospective observational cohort study. J Emerg Med. 2015; 49(6):949–61. https://doi.org/10.1016/j.jemermed.2015.05.034 PMID: 26279514
20. van der Linden MC, Khursheed M, Hooda K, Pines JM, Van Der Linden N. Two emergency departments, 6000 km apart: Differences in patient flow and staff perceptions about crowding. Int Emerg Nurs. 2017; 35:30–6. https://doi.org/10.1016/j.ienj.2017.06.002 PMID: 28659247
21. Jarvis P, Davies T, Mitchell K, Taylor I, Baker M. Does rapid assessment shorten the amount of time patients spend in the emergency department?. British Journal of Hospital Medicine. 2014; 15 (11):648–51.
22. Kelen GD, Scheulen JJ, Hill PM. Effect of an emergency department (ED) managed acute care unit on ED overcrowding and emergency medical services diversion. Acad Emerg Med. 2001; 8(11):1095–100. PMID: 11691675

23. Shetty A, Gunja N, Byth K, Vukasovic M. Senior streaming assessment further evaluation after triage zone: a novel model of care encompassing various emergency department throughput measures. Emerg Med Australas. 2012; 24:374–82. https://doi.org/10.1111/j.1742-6723.2012.01550.x PMID: 22862754

24. Chang AM, Cohen DJ, Lin A, Augustine J, Handel DA, Howell E, et al. Hospital strategies for reducing emergency department crowding: a mixed-methods study. Ann Emerg Med. 2018; 71(4):497–505. https://doi.org/10.1016/j.annemergmed.2017.07.022 PMID: 28844764

25. Holroyd BR, Bullard MJ, Latoszek K, Gordon D, Allen S, Tam S, et al. Impact of a triage liaison physician on emergency department overcrowding and throughput: a randomized controlled trial. Acad Emerg Med. 2007; 14(8):702–8. https://doi.org/10.1197/j.aem.2007.04.018 PMID: 17656607

26. Jang JY, Shin SD, Lee EJ, Park CB, Song KJ, Singer AJ. Use of a comprehensive metabolic panel point-of-care test to reduce length of stay in the emergency department: a randomized controlled trial. Ann Emerg Med. 2013; 61(2):145–51. https://doi.org/10.1016/j.annemergmed.2012.07.021 PMID: 22901564

27. Begaz T, Elashoff D, Grogan TR, Talan D, Taira BR. Initiating diagnostic studies on patients with abdominal pain in the waiting room decreases time spent in an emergency department bed: a randomized controlled trial. Ann Emerg Med. 2017; 69(3):298–307. https://doi.org/10.1016/j.annemergmed.2016.06.040 PMID: 27527398

28. Douma MJ, Drake CA, O'Dochartaigh D, Smith KE. A pragmatic randomized evaluation of a nurse-initiated protocol to improve timeliness of care in an urban emergency department. Ann Emerg Med. 2016; 68(5):546–52. https://doi.org/10.1016/j.annemergmed.2016.06.019 PMID: 27480203

29. Bond K, Ospina MB, Blitz S, Afilalo M, Campbell SG, Bullard M, et al. Frequency, determinants and impact of overcrowding in emergency departments in Canada. Healthcare Quarterly. 2007; 10(4):32–40. PMID: 18019897

30. Derlet RW, Richards JR. Emergency department crowding in Florida, New York, and Texas. Southern Medical Journal. 2002; 95(8):846–9. PMID: 12190219

31. Estey A, Ness K, Saunders DL, Alibhai A, Bear RA. Understanding the causes of overcrowding in emergency departments in the Capital Health Region in Alberta: a focus group study. CJEM. 2003; 5 (2):87–94. PMID: 17475097

32. Anantharaman V. Impact of health care system interventions on emergency department utilization and overcrowding in Singapore. Int J Emerg Med. 2008; 1(1):11–20. https://doi.org/10.1007/s12245-008-0004-8 PMID: 19384496

33. Arain M, Campbell MJ, Nicholl JP. Impact of a GP-led walk-in centre on NHS emergency departments. Emerg Med J. 2015; 32(4):295–300. https://doi.org/10.1136/emermed-2013-202410 PMID: 24406328

34. Arya R, Wei G, McCoy JV, Crane J, Ohman-Strickland P, Eisenstein RM. Decreasing length of stay in the emergency department with a split emergency severity index 3 patient flow model. Acad Emerg Med. 2013; 20(11):1171–9. https://doi.org/10.1111/acem.12249 PMID: 24238321

35. Asha SE, Ajami A. Improvement in emergency department length of stay using a nurse-led 'emergency journey coordinator': a before/after study. Emerg Med Australas. 2014; 26(2):158–63. https://doi.org/10.1111/1742-6723.12201 PMID: 24708005

36. Barrett L, Ford S, Ward-Smith P. A bed management strategy for overcrowding in the emergency department. Nursing Economics. 2012; 30(2):82–5. PMID: 22558725

37. Buckley DJ, Curtis PW, McGirr JG. The effect of a general practice after-hours clinic on emergency department presentations: a regression time series analysis. Health Care. 2010; 192(8):448–51.

38. Burke JA, Greenslade J, Chabrowska J, Greenslade K, Jones S, Montana J, et al. Two hour evaluation and referral model for shorter turnaround times in the emergency department. Emerg Med Australas. 2017; 29(3):315–23. https://doi.org/10.1111/1742-6723.12781 PMID: 28455884

39. Burley G, Bendyk H, Whelchel C. Managing the storm: an emergency department capacity strategy. Journal for Healthcare Quality. 2007; 29(1):19–28. PMID: 17518029

40. Burstrom L, Engstro M-L, Castren M, Wiklund T, Enlund M. Improved quality and efficiency after the introduction of physician-led team triage in an emergency department. Upsala Journal of Medical Sciences. 2016; 121(1):38–44. https://doi.org/10.3109/03009734.2015.1100223 PMID: 26553523

41. Cha WC, Song KJ, Cho JS, Singer AJ, Shin SD. The long-term effect of an independent capacity protocol on emergency department length of stay: a before and after study. Yonsei Med J. 2015; 56 (5):1428–36. https://doi.org/10.3349/ymj.2015.56.5.1428 PMID: 26256991

42. Copeland J, Gray A. A daytime fast track improves throughput in a single physician coverage emergency department. CJEM 2015; 17(6):648–55. https://doi.org/10.1017/cem.2015.41 PMID: 26063177

43. Dolton P, Pathania V. Can increased primary care access reduce demand for emergency care? Evidence from England's 7-day GP opening. J Health Econ. 2016; 49:193–208. https://doi.org/10.1016/j.jhealeco.2016.05.002 PMID: 27395472

44. Fulbrook P, Jessup M, Kinnear F. Implementation and evaluation of a 'Navigator' role to improve emergency department throughput. Australas Emerg Nurs J. 2017; 20(3):114–21. https://doi.org/10.1016/j.aenj.2017.05.004 PMID: 28624270

45. Han JH, France DJ, Levin SR, Jones ID, Storrow AB, Aronsky D. The effect of physician triage on emergency department length of stay. J Emerg Med. 2010; 39(2):227–33. https://doi.org/10.1016/j.jemermed.2008.10.006 PMID: 19168306

46. Howell E, Bessman E, Kravet S, Kolodner K, Marshall R, Wright S. Active bed management by hospitalists and emergency department throughput. Ann Intern Med. 2008; 149(11):804–10. PMID: 19047027

47. Imperato J, Morris DS, Binder D, Fischer C, Patrick J, Dahomey Sanchez L, et al. Physician in triage improves emergency department patient throughput. Int Emerg Med. 2012; 7:457–62. https://doi.org/10.1007/s11739-012-0839-0 PMID: 22865230

48. Jones P, Wells S, Harper A, Le Fevre J, Stewart J, Curtis E, et al. Impact of a national time target for ED length of stay on patient outcomes. NZMJ. 2017; 130(1455):15–34.

49. Kim MJ, Park JM, Je SM, You JS, Park YS, Chung HS, et al. Effects of a short text message reminder system on emergency department length of stay. Int J Med Inform. 2012; 81(5):296–302. https://doi.org/10.1016/j.ijmedinf.2012.01.001 PMID: 22300639

50. Lauks J, Mramor B, Baumgartl K, Maier H, Nickel CH, Bingisser R. Medical team evaluation: effect on emergency department waiting time and length of stay. PLoS ONE. 2016; 11(4). https://doi.org/10.1371/journal.pone.0154372 PMID: 27104911

51. Lee IH, Chen CT, Lee YT, Hsu YS, Lu CL, Huang HH, et al. A new strategy for emergency department crowding: high-turnover utility bed intervention. Journal of the Chinese Medical Association. 2017; 80(5):297–302. https://doi.org/10.1016/j.jcma.2016.11.002 PMID: 28202338

52. Lee-Lewandrowski E, Corboy D, Lewandrowski K, Sinclair J, McDermot S, Benzer TI. Implementation of a point-of-care satellite laboratory in the emergency department of an academic medical center. Arch Pathol Lab Med. 2003; 127:456–60. https://doi.org/10.1043/0003-9985(2003)127<0456:IOAPSL>2.0.CO;2 PMID: 12683874

53. Lee-Lewandrowski E, Nichols J, Van Cott E, Grisson R, Louissaint A, Benzer T, et al. Implementation of a rapid whole blood D-dimer test in the emergency department of an urban academic medical center: impact on ED length of stay and ancillary test utilization. Am J Clin Pathol. 2009; 132(3):326–31. https://doi.org/10.1309/AJCP6US3ILGEAREE PMID: 19687307

54. Mason S, Weber EJ, Coster J, Freeman J, Locker T. Time patients spend in the emergency department: England's 4-hour rule-a case of hitting the target but missing the point? Ann Emerg Med. 2012; 59(5):341–9. https://doi.org/10.1016/j.annemergmed.2011.08.017 PMID: 22088495

55. McGrath J, LeGare A, Hermanson L, Repplinger MD. The impact of a flexible care area on throughput measures in an academic emergency department. J Emerg Nurs. 2015; 41:503–9. https://doi.org/10.1016/j.jen.2015.06.002 PMID: 26296717

56. McHugh M, Van Dyke K, Howell E, Adams F, Moss D, Yonek J. Changes in patient flow among five hospitals participating in a learning collaborative. Journal for Healthcare Quality. 2013; 35(1):21–9. https://doi.org/10.1111/j.1945-1474.2011.00163.x PMID: 22092988

57. Mumma BE, McCue JY, Li CS, Holmes JF. Effects of emergency department expansion on emergency department patient flow. Acad Emerg Med. 2014; 21(5):504–9. https://doi.org/10.1111/acem.12366 PMID: 24842500

58. Nagree Y, Ercleve TNO, Sprivulis PC. After-hours general practice clinics are unlikely to reduce low acuity patient attendances to metropolitan Perth emergency departments. Aust Health Rev. 2004; 28(3):285–91. PMID: 15595910

59. Ngo H, Forero R, Mountain D, Fatovich D, Man WN, Sprivulis P, et al. Impact of the four-hour rule in Western Australian hospitals: trend analysis of a large record linkage study 2002–2013. Plos One. 2018; 13(3). https://doi.org/10.1371/journal.pone.0193902 PMID: 29538401

60. Partovi SN, Nelson BK, Bryan ED, Walsh MJ. Faculty triage shortens emergency department length of stay. Acad Emerg Med. 2001; 8(10):990–5. PMID: 11581086

61. Patel PB, Combs MA, Vinson DR. Reduction of admit wait times: the effect of a leadership-based program. Acad Emerg Med. 2014; 21:266–73. https://doi.org/10.1111/acem.12327 PMID: 24628751

62. Perera ML, Davies AW, Gnaneswaran N, Giles M, Liew D, Ritchie P, et al. Clearing emergency departments and clogging wards: National Emergency Access Target and the law of unintended consequences. Emerg Med Australas. 2014; 26:549–55. https://doi.org/10.1111/1742-6723.12300 PMID: 25332129

63. Quinn JV, Mahadevan SV, Eggers G, Ouyang H, Norris R. Effects of implementing a rapid admission policy in the ED. Am J Emerg Med. 2007; 25(5):559–63. https://doi.org/10.1016/j.ajem.2006.11.034 PMID: 17543661

64. Sharma A, Inder B. Impact of co-located general practitioner (GP) clinics and patient choice on duration of wait in the emergency department. Emerg Med J. 2011; 28:658–61. https://doi.org/10.1136/emj.2009.086512 PMID: 20668112

65. Shin S, Lee SH, Kim DH, Kim SC, Kim TY, Kang C, et al. The impact of the improvement in internal medicine consultation process on ED length of stay. J Emerg Med. 2018; 36(4):620–4. https://doi.org/10.1016/j.ajem.2017.09.041 PMID: 28970026

66. Singer AJ, Viccellio P, Thode HC Jr., Bock JL, Henry MC. Introduction of a stat laboratory reduces emergency department length of stay. Acad Emerg Med. 2008; 15(4):324–8. https://doi.org/10.1111/j.1553-2712.2008.00065.x PMID: 18370985

67. Sullivan CM, Staib A, Flores J, Aggarwal L, Scanlon A, Martin JH, et al. Aiming to be NEAT: safely improving and sustaining access to emergency care in a tertiary referral hospital. Aust Health Rev. 2014; 38(5):564–74. https://doi.org/10.1071/AH14083 PMID: 25297518

68. Takakuwa K, Shofer F, Abbuhl S. Strategies to deal with emergency department overcrowding: a one-year study on how bedside registration affects patient throughput times. J Emerg Med. 2007; 32 (4):337–42. https://doi.org/10.1016/j.jemermed.2006.07.031 PMID: 17499684

69. Tenbensel T, Chalmers L, Jones P, Appleton-Dyer S, Walton L, Ameratunga S. New Zealand's emergency department target—did it reduce ED length of stay, and if so, how and when? BMC Health Serv Res. 2017; 17. https://doi.org/10.1186/s12913-017-2617-1 PMID: 28950856

70. van der Linden C, Lucas C, van der Linden N, Lindeboom R. Evaluation of a flexible acute admission unit: effects on transfers to other hospitals and patient throughput times. J Emerg Nurs. 2013; 39 (4):340–5. https://doi.org/10.1016/j.jen.2011.09.024 PMID: 22244548

71. White BA, Brown DFM, Sinclair J, Chang Y, Carignan S, McIntyre J, et al. Supplemented triage and rapid treatment (START) improves performance measures in the emergency department. J Emerg Med. 2012; 42(3):332–28. https://doi.org/10.1016/j.jemermed.2010.04.022 PMID: 20554420

72. Whittaker W, Anselmi L, Kristensen SR, Lau YS, Bailey S, Bower P, et al. Associations between extending access to primary care and emergency department visits: a difference-in-differences analysis. PLoS Med. 2016; 13(9):e1002113. https://doi.org/10.1371/journal.pmed.1002113 PMID: 27598248

73. Willard E, Carlton EF, Moffat L, Barth BE. A full-capacity protocol allows for increased emergency patient volume and hospital admissions. J Emerg Nurs. 2017; 43(5):413–8. https://doi.org/10.1016/j.jen.2017.01.007 PMID: 28456336

74. Chiu IM, Lin YR, Syue YJ, Kung CT, Wu KH, Li CJ. The influence of crowding on clinical practice in the emergency department. Am J Emerg Med. 2018; 36(1):56–60. https://doi.org/10.1016/j.ajem.2017.07.011 PMID: 28705743

75. Diercks DB, Roe MT, Chen AY, Peacock WF, Kirk JD, Pollack J, Charles V., et al. Prolonged emergency department stays of non–ST-segment-elevation myocardial infarction patients are associated with worse adherence to the American College of Cardiology/American Heart Association guidelines for management and increased adverse events. Health Policy and Clinical Practice. 2007; 50(5):489–96. https://doi.org/10.1016/j.annemergmed.2007.03.033 PMID: 17583379

76. Fee C, Weber EJ, Maak CA, Bacchetti P. Effect of emergency department crowding on time to antibiotics in patients admitted with community-acquired pneumonia. Ann Emerg Med. 2007; 50(5):501–9, 9 e1. https://doi.org/10.1016/j.annemergmed.2007.08.003 PMID: 17913300

77. Gaieski DF, Agarwal AK, Mikkelsen ME, Drumheller B, Cham Sante S, Shofer FS, et al. The impact of ED crowding on early interventions and mortality in patients with severe sepsis. Am J Emerg Med. 2017; 35(7):953–60. https://doi.org/10.1016/j.ajem.2017.01.061 PMID: 28233644

78. Hwang U, Richardson LD, Sonuyi TO, Morrison RS. The effect of emergency department crowding on the management of pain in older adults with hip fracture. J Am Geriatr Soc. 2006; 54(2):270–5. https://doi.org/10.1111/j.1532-5415.2005.00587.x PMID: 16460378

79. Hwang U, Richardson L, Livote E, Harris B, Spencer N, Sean Morrison R. Emergency department crowding and decreased quality of pain care. Acad Emerg Med. 2008; 15(12):1248–55. https://doi.org/10.1111/j.1553-2712.2008.00267.x PMID: 18945239

80. Jo S, Jeong T, Jin YH, Lee JB, Yoon J, Park B. ED crowding is associated with inpatient mortality among critically ill patients admitted via the ED: post hoc analysis from a retrospective study. Am J Emerg Med. 2015; 33:1725–31. https://doi.org/10.1016/j.ajem.2015.08.004 PMID: 26336833

81. Kulstad EB, Kelley KM. Overcrowding is associated with delays in percutaneous coronary intervention for acute myocardial infarction. Int J Emerg Med. 2009; 2(3):149–54. https://doi.org/10.1007/s12245-009-0107-x PMID: 20157464

82. Liew D, Liew D, Kennedy MP. Emergency department length of stay independently predicts excess inpatient length of stay. Med J Aust. 2003; 179:524–6. PMID: 14609414

83. Liu SW, Chang Y, Weissman JS, Griffey RT, Thomas J, Nergui S, et al. An empirical assessment of boarding and quality of care: delays in care among chest pain, pneumonia, and cellulitis patients. Acad Emerg Med. 2011; 18:1339–48. https://doi.org/10.1111/j.1553-2712.2011.01082.x PMID: 21692902

84. McCarthy ML, Zeger SL, Ding R, Levin SR, Desmond JS, Lee J, et al. Crowding delays treatment and lengthens emergency department length of stay, even among high-acuity patients. Ann Emerg Med. 2009; 54(4):492–503 e4. https://doi.org/10.1016/j.annemergmed.2009.03.006 PMID: 19423188

85. McCusker J, Vadeboncoeur A, Levesque J-F, Ciampi A, Belzile E. Increases in emergency department occupancy are associated with adverse 30-day outcomes. Acad Emerg Med. 2014; 21:1092–100. https://doi.org/10.1111/acem.12480 PMID: 25308131

86. Medley DB, Morris JE, Stone CK, Song J, Delmas T, Thakrar K. An association between occupancy rates in the emergency department and rates of violence toward staff. J Emerg Med. 2012; 43(4):736–44. https://doi.org/10.1016/j.jemermed.2011.06.131 PMID: 22325552

87. Mills AM, Shofer FS, Chen EH, Hollander JE, Pines JM. The association between emergency department crowding and analgesia administration in acute abdominal pain patients. Acad Emerg Med. 2009; 16:603–8. https://doi.org/10.1111/j.1553-2712.2009.00441.x PMID: 19549018

88. Nippak PMD, Winston IW, Ikeda-Douglas CJ, Marion AM, VandenBorek M. Is there a relation between emergency department and inpatient lengths of stay? Can J Rural Med. 2014; 19(1):12–20. PMID: 24398353

89. Pines JM, Hollander JE, Localio AR, Metlay JP. The association between emergency department crowding and hospital performance on antibiotic timing for pneumonia and percutaneous intervention for myocardial infarction. Acad Emerg Med. 2006; 13(8):873–8. https://doi.org/10.1197/j.aem.2006.03.568 PMID: 16766743

90. Pines JM, Localio AR, Hollander JE, Baxt WG, Lee H, Phillips C, et al. The impact of emergency department crowding measures on time to antibiotics for patients with community-acquired pneumonia. Ann Emerg Med. 2007; 50(5):510–6. https://doi.org/10.1016/j.annemergmed.2007.07.021 PMID: 17913298

91. Pines JM, Hollander JE. Emergency department crowding is associated with poor care for patients with severe pain. Ann Emerg Med. 2008; 51(1):1–5. https://doi.org/10.1016/j.annemergmed.2007.07.008 PMID: 17913299

92. Pines JM, Pollack CV Jr., Diercks DB, Chang AM, Shofer FS, Hollander JE. The association between emergency department crowding and adverse cardiovascular outcomes in patients with chest pain. Acad Emerg Med. 2009; 16(7):617–25. https://doi.org/10.1111/j.1553-2712.2009.00456.x PMID: 19549010

93. Pines JM, Shofer FS, Isserman JA, Abbuhl SB, Mills AM. The effect of emergency department crowding on analgesia in patients with back pain in two hospitals. Acad Emerg Med. 2010; 17:276–83. https://doi.org/10.1111/j.1553-2712.2009.00676.x PMID: 20370760

94. Reznek MA, Murray E, Youngren MN, Durham NT, Michael SS. Door-to-imaging time for acute stroke patients is adversely affected by emergency department crowding. Stroke. 2017; 48(1):49–54. https://doi.org/10.1161/STROKEAHA.116.015131 PMID: 27856953

95. Richardson DB. The access-block effect: relationship between delay to reaching an inpatient bed and inpatient length of stay. Med J Aust. 2002; 177:492–5. PMID: 12405891

96. Richardson DB. Increase in patient mortality at 10 days associated with emergency department overcrowding. Med J Aust. 2006; 184(5):213–6. PMID: 16515430

97. Richardson D, McMahon KL. Emergency department access block occupancy predicts delay to surgery in patients with fractured neck of femur. Emerg Med Australas. 2009; 21(4):304–8. https://doi.org/10.1111/j.1742-6723.2009.01201.x PMID: 19682016

98. Sikka R, Mehta S, Kaucky C, Kulstad EB. ED crowding is associated with an increased time to pneumonia treatment. Am J Emerg Med. 2010; 28:809–12. https://doi.org/10.1016/j.ajem.2009.06.023 PMID: 20837259

99. Singer AJ, Thode HC Jr., Viccellio P, Pines JM. The association between length of emergency department boarding and mortality. Acad Emerg Med. 2011; 18(12):1324–9. https://doi.org/10.1111/j.1553-2712.2011.01236.x PMID: 22168198

100. Spirvulis PC, Da Silva J-A, Jacobs IG, Frazer AR, Jelinek GA. The association between hospital overcrowding and mortality among patients admitted via Western Australian emergency departments. Med J Aust. 2006; 184(5):208–12. PMID: 16515429

101. Sun BC, Hsia RY, Weiss RE, Zingmond D, Liang LJ, Han W, et al. Effect of emergency department crowding on outcomes of admitted patients. Ann Emerg Med. 2013; 61(6):605–11 e6. https://doi.org/10.1016/j.annemergmed.2012.10.026 PMID: 23218508

102. Tekwani KL, Kerem Y, Mistry CD, Sayger BM, Kulstad EB. Emergency department crowding is associated with reduced satisfaction scores in patients discharged from the emergency department. West J Emerg Med. 2013; 14(1):11–5. https://doi.org/10.5811/westjem.2011.11.11456 PMID: 23447751

103. Tsai MT, Yen YL, Su CM, Hung CW, Kung CT, Wu KH, et al. The influence of emergency department crowding on the efficiency of care for acute stroke patients. Int J Qual Saf Healthcare. 2016; 28 (6):774–8. https://doi.org/10.1093/intqhc/mzw109 PMID: 27678127

104. van der Linden MC, Meester B, van der Linden N. Emergency department crowding affects triage processes. Int Emerg Nurs. 2016; 29:27–31. https://doi.org/10.1016/j.ienj.2016.02.003 PMID: 26970907

105. White BA, Biddinger PD, Chang Y, Grabowski B, Carignan S, Brown DFM. Boarding inpatients in the emergency department increases discharged patient length of stay. J Emerg Med. 2013; 44(1):230–5. https://doi.org/10.1016/j.jemermed.2012.05.007 PMID: 22766404

106. Wickman L, Svensson P, Djarv T. Effect of crowding on length of stay for common chief complaints in the emergency department: A STROBE cohort study. Medicine. 2017; 96(44). https://doi.org/10.1097/md.0000000000008457 PMID: 29095294

107. Zhou J-C, Pan K-H, Zhou D-Y, Zheng S-W, Zhu J-Q, Xu Q-P, et al. High hospital occupancy is associated with increased risk for patients boarding in the emergency department. Am J Emerg Med. 2012; 125:416.e1–.e7. https://doi.org/10.1016/j.amjmed.2011.07.030 PMID: 22306273

108. Aboagye-Sarfo P, Mai Q, Sanfilippo FM, Preen DB, Stewart LM, Fatovich DM. Growth in Western Australian emergency department demand during 2007–2013 is due to people with urgent and complex care needs. Emerg Med Australas. 2015; 27(3):202–9. https://doi.org/10.1111/1742-6723.12396 PMID: 25940805

109. Cowling TE, Cecil EV, Soljak MA, Lee JT, Millett C, Majeed A, et al. Access to primary care and visits to emergency departments in England: a cross-sectional, population-based study. PLoS One. 2013; 8 (6):e66699. https://doi.org/10.1371/journal.pone.0066699 PMID: 23776694

110. Dunn R. Reduced access block causes shorter emergency department waiting times: An historical control observational study. Emergency Medicine. 2003; 15:232–8. PMID: 12786644

111. Fatovich DM, Nagree Y, Sprivulis P. Access block causes emergency department overcrowding and ambulance diversion in Perth, Western Australia. Emerg Med J. 2005; 22(5):351–4. https://doi.org/10.1136/emj.2004.018002 PMID: 15843704

112. Forster AJ, Stiell I, Wells G, Lee AJ, van Walraven C. The effect of hospital occupancy on emergency department length of stay and patient disposition. Acad Emerg Med. 2003; 10(2):127–33. PMID: 12574009

113. Kawano T, Nishiyama K, Hayashi H. Adding more junior residents may worsen emergency department crowding. PLoS One. 2014; 9(11):e110801. https://doi.org/10.1371/journal.pone.0110801 PMID: 25369063

114. Kawano T, Nishiyama K, Anan H, Tujimura Y. Direct relationship between aging and overcrowding in the ED, and a calculation formula for demand projection: a cross-sectional study. Emerg Med J. 2014; 31(1):19–23. https://doi.org/10.1136/emermed-2012-202050 PMID: 23302506

115. Knapman M, Bonner A. Overcrowding in medium-volume emergency departments: effects of aged patients in emergency departments on wait times for non-emergent triage-level patients. Int J Nurs Pract. 2010; 16(3):310–7. https://doi.org/10.1111/j.1440-172X.2010.01846.x PMID: 20618543

116. Lucas R, Farley H, Twanmoh J, Urumov A, Olsen N, Evans B, et al. Emergency department patient flow: the influence of hospital census variables on emergency department length of stay. Acad Emerg Med. 2009; 16:597–602. https://doi.org/10.1111/j.1553-2712.2009.00397.x PMID: 19438415

117. Moineddin R, Meaney C, Agha M, Zagorski B, Glazier RH. Modeling factors influencing the demand for emergency department services in Ontario: a comparison of methods. BMC Emerg Med. 2011; 11:13. https://doi.org/10.1186/1471-227X-11-13 PMID: 21854606

118. Sprivulis P. Estimation of the general practice workload of a metropolitan teaching hospital emergency department. Emergency Medicine. 2003; 15:32–7. PMID: 12656784

119. Allen P, Cheek C, Foster S, Ruigrok M, Wilson D, Shires L. Low acuity and general practice-type presentations to emergency departments: a rural perspective. Emerg Med Australas. 2015; 27(2):113–8. https://doi.org/10.1111/1742-6723.12366 PMID: 25720647

120. Nagree Y, Camarda VJ, Fatovich DM, Cameron PA, Dey I, Gosbell AD, et al. Quantifying the proportion of general practice and low-acuity patients in the emergency department. Med J Aust. 2013; 198 (11):612–5. PMID: 23919709

121. Morris ZS, Boyle A, Beniuk K, Robinson S. Emergency department crowding: towards an agenda for evidence-based intervention. Emerg Med J. 2012; 29(6):460–6. https://doi.org/10.1136/emj.2010.107078 PMID: 21653203

15/9/2018

Dear Dr. Morley,

I am writing to let you know that *PLOS ONE* Editors have selected your *PLOS ONE* paper, "Emergency department crowding: A systematic review of causes, consequences and solutions," to be highlighted on the journal homepage. We very much enjoyed reading about your work and would like to thank you for submitting your paper to *PLOS ONE.*

If we can be of any further assistance please do not hesitate to get in touch.

Best wishes,

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Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	Page 1 (title)
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	Page 1-2 (abstract)
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	Page 1-2
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	Page 2
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	Page 4
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Page 3
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	Page 3
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Supplementary material (S1)
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Page 3-4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Page 3-4
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	Page 3
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	Page 3

Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	Pages 7-19
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	N/A
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	Page 20
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Page 4
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Pages 7-19
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Pages 7-19
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	Pages 7-19
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	Page 20
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	Page 38-43
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	Page 43-44
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	Page 44
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	Acknowledgements

The following search strategy is an example of the strategy used on all databases. The search terms were selected based on commonly cited keywords in the literature around emergency department crowding.

Medline using Ovid (Jan 2000 to Aug 2016)

1. Accident and emergency **"OR"** ED **"OR"** Emergency Department **"OR"** Emergency service
2. Crowding **"OR"** Overcrowding **"OR"** Congestion **"OR"** Utilisation
3. #1 **"AND"** #2
4. Consequences **"OR"** Outcomes **"OR"** Harm **"OR"** Mortality **"OR"** Negative impact
5. Cause
6. Solution **"OR"** Strategies **"OR"** Intervention
7. #3 **"AND"** #4
8. #3 **"AND"** #5
9. #3 **"AND"** #6

LIMITS: English language AND peer-reviewed journal article AND Jan 1st 2000-Current

Databases searched with dates of search and results.

Database	Date Search	Results
Medline using Ovid	June 13th 2018	1019
Web of science	June 13th 2018	1289
Embase	June 13th 2018	1393
CINAHL	June 13th 2018	2065

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Planning for the future: Emergency department presentation patterns in Tasmania, Australia

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ARTICLE INFO

Keywords:
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Demand
Health-seeking behaviour
Decision making
Crowding

ABSTRACT

Background: Emergency department crowding and associated adverse outcomes are major issues in health care systems worldwide. The Australian government has highlighted the need to analyse emergency presentations to inform system redesign.

Objective: To describe the profile of emergency department presentations by Tasmanian residents to emergency departments over four years, and examine regional variations.

Method: A retrospective analysis of emergency department data for Tasmania's public hospitals over four financial years, 2010–11 to 2013–14, was undertaken. Descriptive statistics were used to identify patterns in Tasmanian state-wide emergency presentations, as well as disparities between Tasmania's three regions (South, North and North-West). Regression analysis was undertaken to test if changes were significant.

Results: State-wide presentations increased by 3.4% (139,352–144,130) over the four years. Regional variations included an increase in presentations of 16% in the South, 5.1% in the North and a decrease of 3.9% in the North-West. Per capita presentations were consistently lowest in the South and highest in the North-West. The South recorded a significant increase in per capita presentations of those aged 75 and over ($p = 0.001$), increasing at a rate of 12.5 per 1000 residents per annum (95% CI 5.8–19.2).

Conclusion: There is regional variation in emergency demand and utilisation in Tasmania. The results indicate that recent increases are predominantly occurring in the South, including in the elderly, and the reasons for this warrant further investigation.

1. Introduction

Increased presentations to Emergency Departments (EDs) contributing to crowding, and its associated adverse outcomes, are major issues in Australia and around the world [1,2]. Unfavourable outcomes of ED crowding include prolonged length of stay in ED for both high and low acuity presentations [3], and increased in-patient mortality [4–6]. Australia experienced a 21% increase in demand for care at public hospital EDs over the five financial years to 2013–14 [7]. The increase in ED presentations is not simply explained by the national population growth rate and aging of the population [8].

Research investigating the probability of an individual's attendance at an ED has highlighted particular groups whom are more likely to attend. In Australia, those living in outer regional, remote and very remote areas, as well as those living in lower socio-economic areas, are more likely to visit an ED than those living in major cities and areas of higher socio-economic advantage [9]. Older Australians have also been highlighted as being over represented in EDs [9].

These drivers of ED utilisation are particularly relevant in Tasmania where all of the state is classified as either regional or remote [10]. In 2013–14, 34% of Tasmanians were classified as residing in either outer regional, remote or very remote areas, compared to 11% for Australia as a whole [10]. In addition, 32.9% of Tasmanians live in the most disadvantaged quartile of the Socio-Economic Indexes for Areas (SEIFA) index [11]. Of all Australian states and territories, Tasmania has the highest proportion of people aged over 65 years, accounting for 16.8% of the state's population in 2014 [11]. In Australia, both the Commonwealth and Tasmanian governments have highlighted the importance of identifying and analysing sources of ED presentations as a major priority [7,12].

The aim of this study was to describe the profile of presentations to Tasmanian EDs, including regional variations, over four financial years,

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2010–11 to 2013–14. The data would provide information regarding demographics of ED users, acuity and time of presentations, mode of arrival, and discharge destination.

2. Methods

2.1. Study setting

Tasmania is Australia's most Southerly and only Island state with a population of 514,800 (2014) [10]. Between July 2012 and July 2015 Tasmania's acute healthcare system operated as three separate Tasmanian Healthcare Organisations (THOs). These THOs were serviced by four public hospital EDs; Launceston General Hospital (LGH) in THO North, North West Regional Hospital (NWRH) and Mersey Community Hospital (MCH) in THO North-West and Royal Hobart Hospital (RHH) in THO South. Each hospital offers 24 h a day ED services.

2.2. Study design

A retrospective analysis of ED presentations to Tasmania's public hospitals over four financial years (2010–11 to 2013–14) was undertaken. The study was approved by the Tasmania Human Research Ethics Committee (application number H13948).

Data for all patients attending the four public hospital EDs in Tasmania were provided by the Tasmanian State Department of Health and Human Services (DHHS). The DHHS data contains de-identified demographic, administrative and clinical information pertaining to all ED presentations.

In Australia the Statistical Area-level 2 (SA2) code is the base spatial unit used to collect statistics. Collectively the SA2s cover the whole of Australia without gaps or overlaps (average population 10,000) [13]. Patients' places of residence were assigned to one of Tasmania's three regions, South, North or North-West (NW) using SA2 codes. This excluded presentations to Tasmanian EDs by non-Tasmanians, indicating only patterns of ED usage by Tasmanians. Similarly, in sub-group analyses of presentations in a particular region, only residents of that region were counted.

All patients who present to an ED in Australia are assigned one of five possible categories of the Australian Triage Scale (ATS) [14]. ATS 1 represents the most urgent or highest acuity group with ATS 5 representing the least urgent or lowest acuity group. For ease of comparison in this study, triage categories were grouped into ATS 4 and 5 (low acuity presentations (LAPs)) and ATS 1–3 (high acuity presentations).

Data were coded to identify patients who attended the ED in the out-of-hours period. Using a definition applied by Primary Health Tasmania (PHT) [15], out-of-hours included before 8am and after 6 pm on Monday to Friday, before 8am and after 12 pm on Saturday, and all day on Sunday and public holidays.

2.3. Data analysis

Data were obtained for four financial years, July 1st 2011 to June 30th 2014 inclusive. Descriptive statistics were used to compare changes in mode of arrival to the ED, urgency of presentation, in-hours versus out-of-hours attendance and discharge destination. Linear interpolation was applied to annual population estimates obtained from the Australian Bureau of Statistics (ABS) [16] to estimate quarterly populations. These figures were used to calculate per capita presentations for the state as a whole and for each of the three regions by five-year age bands. Linear regression analyses were undertaken to test whether changes in per capita presentations were statistically significant ($p < 0.05$). Data were analysed using R version 3.1.2 and Microsoft Office Excel 2013.

3. Results

3.1. Absolute numbers of presentations to Tasmanian EDs by Tasmanians

The data set initially comprised 580,456 presentations. After excluding presentations by non-Tasmanians, the final data set number was 563,649 (2.9% excluded). Presentations to Tasmanian EDs increased from 139,352 to 144,130 (3.4%) from the first year of the study period (2010–11) to the last (2013–14). Over this time the number of patients presenting to the ED who were subsequently admitted to hospital increased by 23% (29,887–36,807), while ambulance arrivals increased by 11.5% (34,689–38,672). In the four years, high acuity presentations increased by 6.8% (57,558–61,490) while LAPs increased by 1% (81,403–82,242). Presentations in the out-of-hours period remained relatively stable, with 54% of all presentations occurring during this time in the both the first and last years of the study (data not shown).

3.2. Regional patterns

When the data were disaggregated into regions, different patterns emerged (Table 1). Presentations in the South increased each year of the study and recorded a 16% increase over the four-year period, with increases observed across all five-year age bands. Presentations in the North decreased in the second year (2011–12) but recorded an overall increase of 5.1% between the first and final years. Changes in the North-West varied over the study period, and the region recorded an overall decrease in presentations of 3.9%.

The South recorded increases across all levels of acuity with the greatest increase (25%) for LAPs. The North recorded increases of 5% across both high and LAPs, and the North-West recorded an increase in high-acuity presentations (14%) and a comparative decrease in LAPs (−14%). Whilst all regions recorded an increase in ambulance presentations, particularly in the South (20%), the proportion of ED patients arriving by ambulance varied greatly between regions: 35% in the South, 25% in the North and 20% in the North-West in 2013–14.

Thirty-three per cent of all presenters in the South in 2013–14 were subsequently admitted, an increase of 24% over the study period. The proportion of presentations resulting in admission in the North and the North-West equated to approximately one-fifth of all attenders, with increases over the period of 26% and 28%, respectively (Table 1).

3.3. Per capita presentations

When examining per capita presentations, different patterns emerged for each region (Fig. 1). Although absolute numbers of presentations in the North-West fell over the time period, this region consistently saw greater per capita presentations across all age groups than the other two regions. Residents in the North consistently presented at a greater rate than residents in the South.

3.4. Acuity of presentations

When comparing per capita presentations by level of acuity (Figs. 2 and 3) there was further evidence of regional variation. LAPs in the South increased across all age groups (Fig. 2a), with significant increases seen in all age-bands under 60 years ($p < 0.005$). LAPs in those aged under 60 years in the South increased at a rate of 9.9 per 1000 residents per annum (95% confidence interval 7.1–12.7). Conversely, there was a statistically significant decrease in LAPs across the majority of age bands in the North-West (Fig. 2c). High-urgency presentations in the North-West increased at a significant rate in almost all age groups between ages 10–54 years (Fig. 3c). The South recorded increases in high-urgency presentations in some of the older age bands (Fig. 3a). The North recorded increases of 5.4% and 5% in high (Fig. 2b) and low (Fig. 3b) acuity presentations respectively.

Table 1
Comparison of regional Tasmanian ED usage by residents of each region, 2010–11 to 2013–14.

	South (%)			North (%)			North-West (%)		
	2010–11	2013–14	% Change	2010–11	2013–14	% Change	2010–11	2013–14	% Change
Population	252 805	256 338	1.4	143 369	143 695	0.2	113 990	113 897	-0.1
Total number of Presentations	42 712	49 539	16	39 302	41 306	5.1	48 917	47 026	-3.9
ARRIVAL MODE									
Emergency Amb.	14 275 (33)	17 113 (35)	20	9 345 (24)	10 226 (25)	9.4	8 687 (18)	9 208 (20)	6.0
"Walk-ins"	27 202 (64)	31 306 (63)	15	29 636 (75)	30 652 (74)	3.4	39 931 (82)	37 380 (79)	-6.4
TIME OF DAY									
In Hours	17 866 (42)	20 947 (42)	17	17 332 (44)	18 243 (44)	5.3	23 035 (47)	21 618 (46)	-6.1
Out-of-Hours	24 846 (58)	28 591 (58)	15	21 970 (56)	23 063 (56)	4.9	25 882 (53)	25 408 (54)	-1.8
AUSTRALIAN TRIAGE SCALE									
1	309 (0.7)	366 (0.7)	18	122 (0.3)	130 (0.3)	6.6	131 (0.3)	169 (0.4)	29
2	3 915 (9)	4 820 (10)	23	2 688 (7)	2 788 (7)	3.7	2 674 (5)	3 756 (8)	40
3	16 385 (38)	16 819 (34)	2.6	13 453 (34)	14 221 (34)	5.7	14 316 (29)	15 659 (33)	9.4
4	16 605 (39)	20 236 (41)	22	21 454 (55)	20 890 (51)	-2.6	25 442 (52)	23 787 (51)	-6.5
5	5 316 (12)	7 106 (14)	34	1 475 (4)	3 175 (8)	115	6 352 (13)	3 647 (8)	43
ATS 1–3	20 609 (48)	22 005 (44)	6.8	16 263 (41)	17 139 (41)	5.4	17 131 (35)	19584 (42)	14
ATS 4 & 5	21 921 (51)	27 342 (55)	25	22 929 (58)	24 065 (58)	5.0	31 494 (65)	27 434 (58)	-14
ED DISCHARGE DESTINATION									
*Non-admitted	29 317 (69)	32 980 (67)	12	32 583 (83)	32 827 (79)	0.7	41 412 (85)	37 390 (79)	-10
#Admitted	13 395 (31)	16 559 (33)	24	6 719 (17)	8 479 (21)	26	7 505 (15)	9 636 (20)	28

* Departed without being admitted, dead on arrival, did not wait, left at own risk.
\# Admitted, referred to another hospital for admission, died in ED.

3.5. Increased presentations in the South

Total presentations in the South increased across all age bands; however, presentations of those aged 75 and over increased at a significant rate (p = 0.001) (Fig. 1). Regression analysis of per capita presentations versus time found that presentations of those aged 75 and over in the South, between 2010–11 and 2013–14, increased at a rate of 12.5 per 1000 residents per year (95% confidence interval 5.8–19.2).

In 2013–14, 68% of presenters to the RHH aged 75 and over were admitted, versus 29% of those aged less than 75 (OR 5.2, 95% confidence interval 4.9–5.5) (Table 2). The higher proportion of admissions in the older age group was consistent each year of the study. Similarly, the mean length of stay for those age 75 and over was consistently longer than for younger presenters. This remained the case regardless of the outcome of the presentation (Table 2). In 2013–14 patients aged 75 years and older spent over 36,000 h in the RHH ED (data not shown).

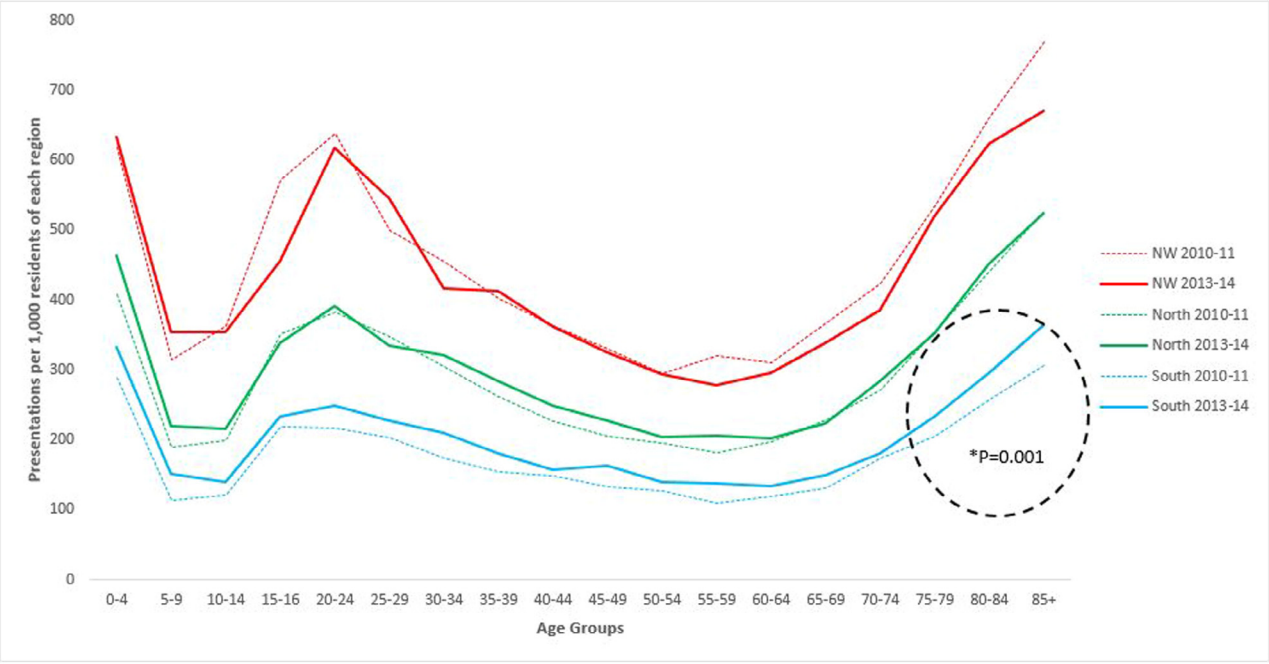

Fig. 1. Per capita presentations to Tasmanian EDs by residents of each region; 2010–11 and 2013–14.

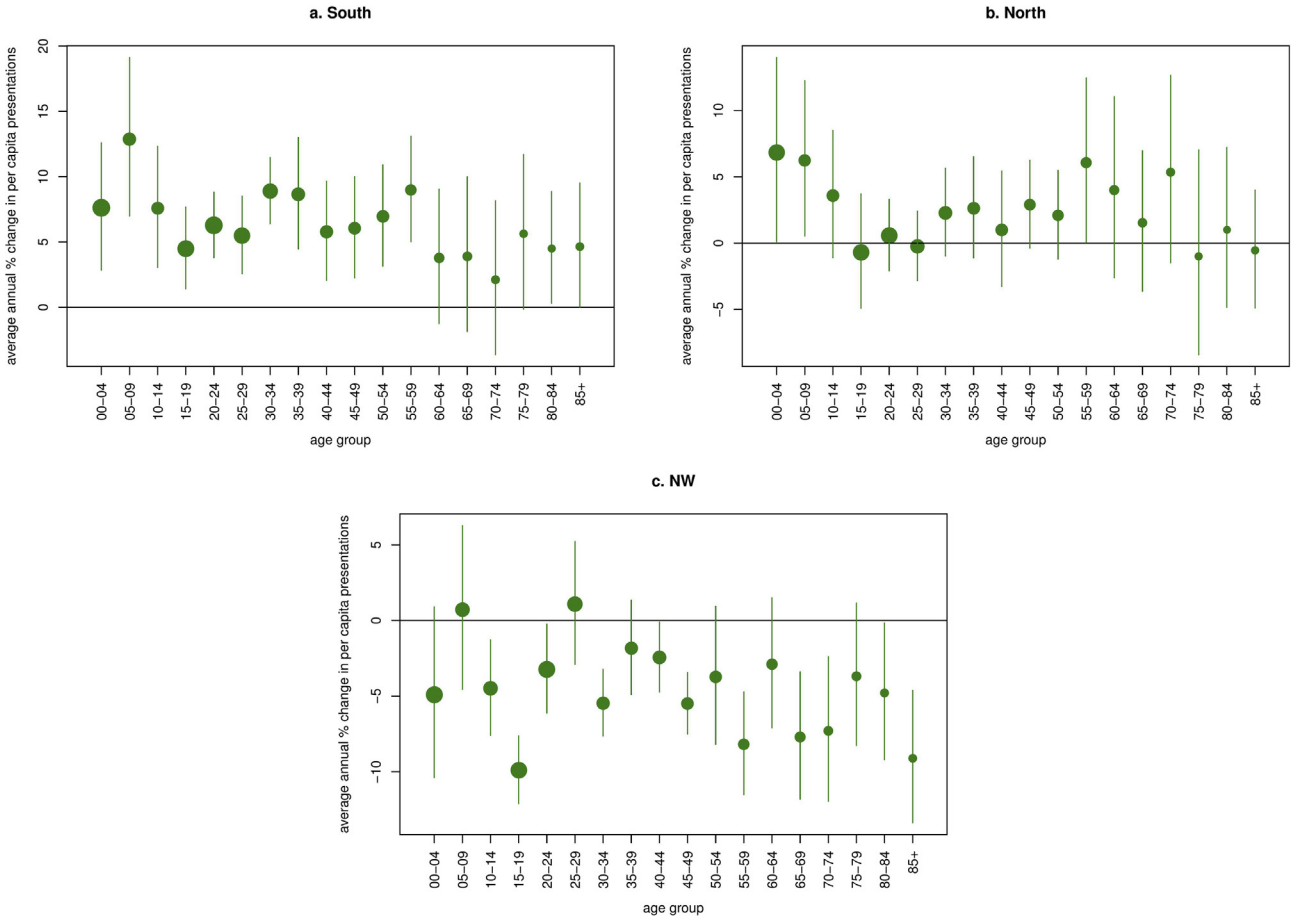

Fig. 2. Annual average percentage change in per capita presentations of #***low acuity*** patients to Tasmanian regional EDs, 2010–11 to 2013–14: a. South, b. North, c. NW. #Australian Triage Categories 3 & 4 combined. The size of the dots donate the actual numbers of presenters in that age group in 2013–14.

4. Discussion

The main finding of this study was the widespread variation in ED usage between Tasmania's three regions. This result can be further divided into three main points. Firstly, residents in the state's North-West present to the ED at a much greater per capita rate than the other two regions, and at a rate greater than the national average [7]. Secondly, in terms of increased presentations, the majority of the increases were in the South of the state. Finally, although presentations in the South of the state increased across all five-year age-bands, there was a significant increase in presentations of those age 75 years and older, across all triage categories.

When considering state-wide ED presentations in the four years under study, there were sizable increases in the proportion of patients arriving by ambulance, presenting with high acuity conditions and being subsequently admitted to hospital. This finding in itself depicts a significant threat to existing ED resources.

4.1. Per capita presentations in the North-West

Residents of the state's North-West presented to ED at a per capita rate of up to 2.5 times that of the South. This large disparity in regional per capita presentations has continued, even allowing for the overall drop in presentations in the North-West. North-West Tasmania is the most rural part of the State, and this is a potential explanation for the high per capita rates of presentation in this region. Callen and colleagues, who undertook a survey of attendees at a rural Australian hospital, highlighted patients' perspectives that rural EDs are an important alternative to primary care, particularly in the after-hours period [17]. Similarly, a previous study undertaken by Cheek and colleagues in NW Tasmania concluded that providing low-acuity care in parallel with more acute services may be the best service model to meet the needs of rural communities [18]. Cheek's suggestion may have been related to the reduced availability of GPs in this rural area. The most recent GP census in Tasmania showed that the North-West had the highest number of patients per full time equivalent GP in the state (1389 people), which was also higher than the national average (1214 people) [19].

The high per capita ED presentations in this region has been reported before [20], with researchers speculating that the EDs in North-West Tasmania 'act as GP super-clinics'. However, here we present a new finding, that there has been a recent decrease of 14% in LAPs in this region, while high acuity presentations have increased by 14% with a corresponding increase in admissions. This finding suggests that rather than using the EDs as GP clinics, residents of the North-West are changing how they utilise the service and are starting to reserve presentations to the ED for more serious conditions. An investigation into what has led to this change in healthcare-utilisation behaviour is warranted. Future research could involve an exploration of changes in local healthcare service provision as it is possible that changes in access to alternative forms of healthcare has led to the recent reduction of LAPs to the EDs in this region.

4.2. Increases in the South

Another regional variation identified is the increase in presentations in the South of the state compared to a decrease in the North-West and a modest increase in the North. The increase in the South equated to an

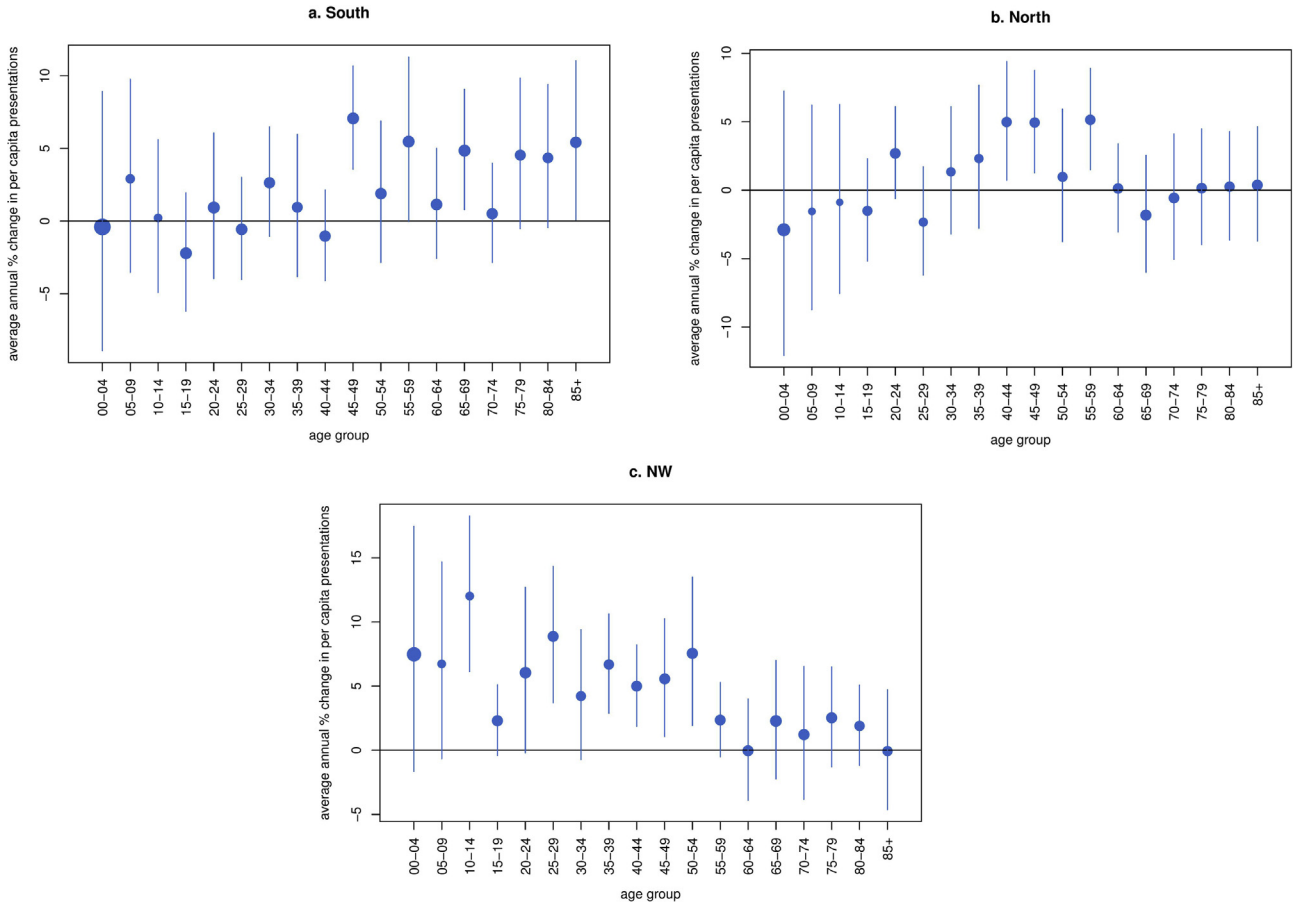

Fig. 3. Annual average percentage change in per capita presentations of [#]***high acuity*** patients to Tasmanian regional EDs, 2010–11 to 2013–14: a. South, b. North, c. NW. [#]Australian Triage Categories 1, 2 & 3 combined. The size of the dots donate the actual numbers of presenters in that age group in 2013–14.

Table 2
Comparison of [#]LOS in the South between patients aged < 75 years and patients aged ≥75 years.

	< 75				≥75				
	Mean LOS Admitted	Mean LOS Discharged	Mean LOS	% admitted	Mean LOS Admitted	Mean LOS Discharged	Mean LOS	% admitted	Odds of admission (95% CI)
2010–11	9.7 h (585 min)	3.7 h (221 min)	5.3 h (320 min)	27	11.2 h (673 min)	5.0 h (301 min)	9.2 h (553 min)	68	5.6 (5.3–6.0)
2011–12	7.3 h (440 min)	3.3 h (196 min)	4.3 h (260 min)	26	8.1 h (488 min)	4.8 h (289 min)	7.0 h (418 min)	65	5.2 (4.9–5.6)
2012–13	8.0 h (481 min)	3.1 h (187 min)	4.3 h (261 min)	25	9.3 h (558 min)	4.2 h (252 min)	7.4 h (446 min)	63	5.2 (4.8–5.5)
2013–14	7.1 h (426 min)	2.9 h (176 min)	4.1 h (249 min)	29	8.9 h (532 min)	3.7 h (224 min)	7.2 h (434 min)	68	5.2 (4.9–5.5)

[#] Length of Stay.

annual average increase of 5.1%, greater than that reported by other Australian regions [21,22]. This increase was not explained by population growth, as the population of this region increased by only 1.4% over the four-year period [16]. The majority of the increase was in LAPs (25%). In fact, the majority of the increased presentations by those aged 60 years and under can be attributed to increases in LAPs by patients in this demographic (Fig. 2a).

Interestingly, Dinh and colleagues, who conducted a recent retrospective analysis of ED presentations in New South Wales, covering the five years 2010–2014, reported no increase in LAPs [23]. These researchers used a different definition of low acuity, that is, a definition used by the Australian government for potentially avoidable 'GP-type' presentations. As well as including patients allocated triage categories 4 or 5, it also included patients who were self-referred and who were subsequently discharged to their usual place of residence. However, when our data were reanalysed using this alternative definition, we still found a 21% increase in LAPs in the South of Tasmania. It is possible the discrepancy lies in the number of LAPs referred by their GP to the ED in the South, as a recent investigation into LAPs in the North of Tasmania reported almost 29% of LAPs had been told to go to the ED by a doctor or a nurse [24]. Unfortunately, identifying self-referred LAPs was outside the scope of this analysis. It is worth noting that the Australian government has recently ceased reporting figures for potentially avoidable 'GP-type' presentations, due to the limitations of the definition [7].

While increased LAPs to the ED may not directly lead to overcrowding, studies have reported reductions in wait time and length of stay in ED for higher acuity patients by diverting LAPs away from the

ED [25], or steaming their care within the ED [26]. Therefore, it is worthwhile trying to understand the reasons patients attend the ED for non-urgent conditions. In a survey of Australian patients who attended EDs during 2013–14, 22% of respondents felt the required care could have been provided by a GP [9]. Unavailability of their GP was the reason given by 23% of these attendees, while 3% believed that the waiting time to see a GP was too long [9]. The proportion of Tasmanian respondents who reported that their GP was unavailable (15.9%) was the lowest in the country [27]. However, in 2012–13 GP type presentations (according to one definition) in Tasmania accounted for 41.9% of all ED presentations, which was substantially above the national average of 32.4% [12].

The drivers behind LAPs to the ED have been investigated in multiple studies that have reported similar contributing factors [1,24,28]. While different methodologies were used in these studies, including interviews [1,28] and surveys [24], all studies identified barriers in accessing primary care and patient perceived urgency of care as factors associated with the decision to attend the ED. Unwin and colleagues [24] concluded that providing more accessible and appropriate services could lead to a reduction in LAPs to the ED. It is feasible that providing increased access to alternative forms of care, coupled with patient education on appropriate use of services could reduce LAPs in the South. However, to identify the strategies most likely to succeed it is important to understand the specific contextual factors that have led to this sustained increase.

Therefore, future research should focus on an investigation of the specific factors that contribute to residents of Tasmanian deciding to seek treatment at the ED for low acuity conditions. It is essential that the opinions and motivations of local presenters are sought, as only they can identify the decision making processes behind their attendance at the ED, and consequently may provide insights into acceptable alternatives to ED for their specific health care needs.

4.3. Presentations by the elderly

When looking at total presentations in the South, there was a significant increase in per capita presentations of people aged 75 and over (Fig. 1). Presentations of those aged 75 years and over at the RHH represent more than 10% all ED presentations and over 22% of all admissions, with the proportion increasing each year of this study. Presentations in this age group are increasing at a rate of 12.5 per 1000 residents per year, with 68% of these presentations resulting in an admission in 2013–14. The amount of time this group spent in the RHH ED in 2013–14 is equivalent to over four ED cubicles per day being occupied by a person aged 75 years or over.

Other Australian studies have identified presentations by the elderly as one of the factors contributing to increased ED presentations. In a ten-year retrospective analysis of all ED presentations in metropolitan Melbourne, older people (defined as aged 70 and over) were identified as being disproportionately represented in ED [29]. Similar to our study, the Melbourne study found older patients spent longer in the ED and were more likely to be admitted than younger adults [29]. A retrospective analysis of ED presentations undertaken in Sydney, Australia attributed a 36% increase in ED presentations over eleven years to be predominantly driven by the growth in acute, elderly presentations requiring hospital admission [30]. A recent Japanese study that investigated the relationship between ED length of stay (LOS) and the trend of an aging society concluded that the age of ED presenters had a significant negative effect on ED crowding, as ED LOS increased proportionately with the mean age of ED presenters [31]. Kawano and colleagues further advised that countries facing the issue of an aging population anticipate the effect this will have on ED crowding and take preventative measures to address the potential impact on the healthcare system [31].

As Tasmanian has the highest mean age of all Australian states and territories any significant or sustained growth in ED presentations of those aged 75 and over is a major concern. Not only is the state population of this demographic forecast to continue increasing, but the burden in terms of time and resources this group place on the ED is already significant. It is important to note that as these results show an increase in per capita presentations, the issue is not simply that a greater number of older people are attending the ED, but each older person in the South is more likely to attend.

This result merits further investigation into the causes behind this significant increase in ED presentations by those aged 75 years and older. Future research could investigate whether older residents of the South are sicker than before, and therefore require more hospital admissions. Additionally, an exploration of older residents' perceptions of access to primary care may yield some insights into what is driving this increased need for emergency care.

4.4. State-wide presentations

Finally, the state-wide analysis identified increases in high acuity presentations and patients arriving by ambulance to the ED. This appears to be consistent with the increased acuity of ED presentations, demonstrated by a 23% increase over four years in the proportion of presentations who were subsequently admitted. The increase in admissions was evident across all three regions (Table 1). Indeed, the admission rate of 33% in the South in 2013–14 was higher than the Australian average for the same period (29%) [7]. A report by the Tasmanian government has previously highlighted the strain that increased hospital admissions are placing on the healthcare system [12]. This report identified Tasmanian EDs as having higher levels of access block than the national average, with 36% of all Tasmanians spending greater than eight hours in the ED, compared with 27% nationally (2012–13) [12].

Similar to the current study, Lowthian and colleagues also identified substantial increases in the proportion of ambulance arrivals, high acuity patients and ED presentations subsequently requiring an admission over a 10-year period in Victoria, Australia [21]. Increased ED presentations related to the growth in high acuity patients was also a finding of a Western Australian (WA) study that examined trends in state-wide ED presentations over seven calendar years (2007–2013) [22].

The current study adds to the growing body of evidence that high acuity patients who require admission to an in-patient bed are contributing substantially to the increase in ED presentations. This result suggests that healthcare policy needs to incorporate effective health promotion measures to keep the population healthier, and to consider whether alternative services for people with chronic diseases can reduce the need for hospital admissions. It is known that solutions to crowding in EDs lie outside of the ED itself, therefore a concerted effort to identify the causes of increased ED presentations and develop system-wide solutions that are both appropriate and acceptable to local residents is necessary.

5. Limitations

ABS population data were used to calculate per capita presentations. Therefore, the patterns of per capita presentations are reliant on these population data, which are estimates based on updates to 2011 Australian census data. Analyses of the trends in clinical diagnoses presenting to ED may be helpful in describing the profile of presentations, but was beyond the scope of this paper.

6. Conclusions

This study provides a comprehensive analysis of patterns of ED presentations by Tasmanian residents over a four-year period. The analyse highlights sizeable regional variations in patterns of ED usage which suggests that interventions aimed at reducing ED presentations

need to be based on local knowledge to ensure local issues are taken into consideration. Results also indicate that a significant proportion of the increase in ED presentations in Tasmania is related to increased presentations by those aged 75 and older in the South of the state. Further research to ascertain the drivers behind these significant changes in healthcare usage in Tasmania, including trends in the types of presenting conditions and referral sources, would provide useful insights into how best to plan for and manage future impacts on hospital resources.

Conflict of interest

None.

Ethical Statement

The study was approved by the Tasmania Human Research Ethics Committee (application number H13948).

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References

[1] Durand AC, Palazzolo S, Tanti-Hardouin N, Gerbeaux P, Sambuc R, Gentile S. Nonurgent patients in emergency departments: rational or irresponsible consumers? Perceptions of professionals and patients. BMC Res Notes 2012;5:525.
[2] Cameron PA. Hospital overcrowding: a threat to patient safety? Med J Aust 2006;184(5):203–4.
[3] McCarthy ML, Zeger SL, Ding R, Levin SR, Desmond JS, Lee J, et al. Crowding delays treatment and lengthens emergency department length of stay, even among high-acuity patients. Ann Emerg Med 2009;54(4). 492.e4–503.e4.
[4] Richardson DB. Increase in patient mortality at 10 days associated with emergency department overcrowding. Med J Aust 2006;184(5):213–6.
[5] Sprivulis PC, Da Silva J-A, Jacobs IG, Frazer AR, Jelinek GA. The association between hospital overcrowding and mortality among patients admitted via Western Australian emergency departments. Med J Aust 2006;184(5):208–12.
[6] Sun BC, Hsia RY, Weiss RE, Zingmond D, Liang LJ, Han W, et al. Effect of emergency department crowding on outcomes of admitted patients. Ann Emerg Med 2013;61(6). 605.e6–11.e6.
[7] Australian Institute of Health and Welfare. Australian Hospital Statistics 2013–2014: Emergency Department Care. Canberra: AIHW; 2014.
[8] Department of Health and Human Services. Rebuilding Tasmania's Health System — Supplement No.4 – Emergency Care. In: DHHS, editor. Hobart 2015.
[9] Patient experiences in Australia: Summary of Findings, 2013–14 [Internet]. 2014 [cited January 16th 2016]. Available from: http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/4839.0~2013-14~Main%20Features~Hospital%20admissions%20and%20emergency%20departments~5.
[10] Regional Population Growth, Australia, 2013-14 [Internet]. 2016 [cited 17 November 2016]. Available from: http://www.abs.gov.au/AUSSTATS/abs@.nsf/Previousproducts/3218.0Main%20Features452013-14?opendocument&tabname=Summary&prodno=3218.0&issue=2013-14&num=&view=.
[11] Tasmanian Medicare Local. Primary Health Indicators Tasmania Report Hobart: Tasmanian Medicare Local Limited; 2015.
[12] The Commission on Delivery of Health Services in Tasmania. Working towards a sustainable health system in Tasmania. Canberra: Commonwealth of Australia; 2014.
[13] 1270.0.55.001 – Australian Statistical Geography Standard (ASGS): Volume 1 – Main Structure and Greater Capital City Statistical Areas [Internet]. Australian Bureau of Statistics. 2010 [cited 21 November 2016]. Available from: http://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/88F6A0EDEB8879C0CA257801000C64D9.
[14] Australasian College for Emergency Medicine. Policy on the Australian triage scale: Australasian College for Emergency Medicine; 1993 [updated July 2013; cited 21 November 2016]. Available from: https://www.acem.org.au/getattachment/693998d7-94be-4ca7-a0e7-3d74cc9b733f/Policy-on-the-Australasian-Triage-Scale.aspx.
[15] Primary Health Tasmania. After Hours Care 2015 [cited 9th November 2015]. Available from: http://www.primaryhealthtas.com.au/programs-services/after-hours-care.
[16] ERP by LGA (ASGS 2014), 2001 to 2014 [Internet]. 2015 [cited February 15th 2015]. Available from: http://stat.abs.gov.au/Index.aspx?QueryId=1268#.
[17] Callen JL, Blundell L, Prgomet M. Emergency department use in a rural Australian setting: are the factors prompting attendance appropriate? Aust Health Rev 2008;32(4):710–20.
[18] Cheek C, Allen P, Shires L, Parry D, Ruigrok M. Low-acuity presentations to regional emergency departments: what is the issue? Emerg Med Aust 2016;28(2):145–52.
[19] Tasmanian Medicare Local. 2014 Census of Tasmanian General Practices. Hobart: Tasmanian Medicare Local Limited; 2015.
[20] Allen P, Cheek C, Foster S, Ruigrok M, Wilson D, Shires L. Low acuity and general practice-type presentations to emergency departments: a rural perspective. Emerg Med Aust 2015;27(2):113–8.
[21] Lowthian JA, Curtis AJ, Jolley DJ, Stoelwinder JU, McNeil JJ, Cameron PA. Demand at the emergency department front door: 10-year trends in presentations. Med J Aust 2012;196(2):128–32.
[22] Aboagye-Sarfo P, Mai Q, Sanfilippo FM, Preen DB, Stewart LM, Fatovich DM. Growth in Western Australian emergency department demand during 2007–2013 is due to people with urgent and complex care needs. Emerg Med Aust 2015;27(3):202–9.
[23] Dinh MM, Berendsen Russell S, Bein KJ, Chalkley DR, Muscatello D, Paoloni R, et al. Statewide retrospective study of low acuity emergency presentations in New South Wales, Australia: who, what, where and why? BMJ Open 2016;6(5):e010964.
[24] Unwin M, Kinsman L, Rigby S. Why are we waiting? Patients' perspectives for accessing emergency department services with non-urgent complaints. Int Emerg Nurs 2016;29:3–8.
[25] Sharma A, Inder B. Impact of co-located general practitioner (GP) clinics and patient choice on duration of wait in the emergency department. Emerg Med Aust 2011;28:658–61.
[26] Shetty A, Gunja N, Byth K, Vukasovic M. Senior streaming assessment further evaluation after triage zone: a novel model of care encompassing various emergency department throughput measures. Emerg Med Aust 2012;24:374–82.
[27] Patient experiences in Australia, 2013-14: Tasmania [Internet]. Commonwealth of Australia. 2015 [cited November 30th 2015]. Available from: http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4839.0.55.0022013-14?OpenDocument.
[28] Shaw EK, Howard J, Clark EC, Etz RS, Arya R, Tallia AF. Decision-making processes of patients who use the emergency department for primary care needs. J Health Care Poor Underserved 2013;24(3):1288–305.
[29] Lowthian J, Curtis A, Stoelwinder J, McNeil J, Cameron P. Emergency demand and repeat attendances by older patients. Int Med J 2013;43(5):554–60.
[30] Dinh MM, Bein KJ, Latt M, Chalkley D, Muscatello D. Age before acuity: the drivers of demand for emergency department services in the Greater Sydney Area. Emerg Med Aust 2015;32(9):708–11.
[31] Kawano T, Nishiyama K, Anan H, Tujimura Y. Direct relationship between aging and overcrowding in the ED, and a calculation formula for demand projection: a cross-sectional study. Emerg Med Aust 2014;31(1):19–23.

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HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

UTAS

09 May 2014

Professor Gregory Peterson
C/- School of Medicine

Sent via email

Dear Professor Peterson

REF NO: H0013948
TITLE: A pilot analysis of Tasmanian hospitals data compiled by DHHS: development of reporting tools for future clinical redesign projects

Document	***Version***	***Date***
Low risk application form		
Privacy form		21 Mar 2014

The Tasmanian Health and Medical Human Research Ethics Committee considered and approved the above documentation on **02 May 2014** to be conducted at the following site(s):

School of Medicine

Please ensure that all investigators involved with this project have cited the approved versions of the documents listed within this letter and use only these versions in conducting this research project.

This approval constitutes ethical clearance by the Health and Medical HREC. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approvals of other bodies or authorities are required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

All committees operating under the Human Research Ethics Committee (Tasmania) Network are registered and required to comply with the *National Statement on the Ethical Conduct in Human Research* (NHMRC 2007 updated 2009).

Therefore, the Chief Investigator's responsibility is to ensure that:

(1) The individual researcher's protocol complies with the HREC approved protocol.

(2) Modifications to the protocol do not proceed until **approval** is obtained in writing from the HREC. Please note that all requests for changes to approved documents must include a version number and date when submitted for review by the HREC.

(3) Section 5.5.3 of the National Statement states:

Researchers have a significant responsibility in monitoring approved research as they are in the best position to observe any adverse events or unexpected outcomes. They should report such events or outcomes promptly to the relevant institution/s and ethical review body/ies and take prompt steps to deal with any unexpected risks.

The appropriate forms for reporting such events in relation to clinical and non-clinical trials and innovations can be located at the website below. All adverse events must be reported regardless of whether or not the event, in your opinion, is a direct effect of the therapeutic goods being tested.
http://www.research.utas.edu.au/human_ethics/medical_forms.htm

(4) All research participants must be provided with the current Patient Information Sheet and Consent Form, unless otherwise approved by the Committee.

(5) The Committee is notified if any investigators are added to, or cease involvement with, the project.

(6) This study has approval for 1 year contingent upon annual review. A *Progress Report* is to be provided on the anniversary date of your approval. Your first report is due 4 May 2015. You will be sent a courtesy reminder closer to this due date.

(7) A *Final Report* and a copy of the published material, either in full or abstract, must be provided at the end of the project.

Should you have any queries please do not hesitate to contact me on (03) 6226 6254.

Yours sincerely

Jude Vienna-Hallam

Digitally signed by Jude Vienna-Hallam
DN: cn=Jude Vienna-Hallam, o=University of Tasmania, ou=Ethics Unit, email=Jude.ViennaHallam@utas.edu.au, c=AU
Date: 2014.06.03 13:12:49 +10'00'

Jude Vienna-Hallam
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Research Integrity and Ethics Unit
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http://www.utas.edu.au/research-admin/home

Patient-perceived access to care is a driver of increased emergency department presentations by the elderly

Claire Morley, Gregory Peterson, Jim Stankovich and Leigh Kinsman
College of Health and Medicine
University of Tasmania
Hobart, Australia

6th Annual Worldwide Nursing Conference (WNC 2018)

ISSN 2315-4330
doi: 10.5176/2315-4330_WNC18.45

UNIVERSITY of TASMANIA | DIVISION OF RESEARCH

Audit Tool Instructions:

This audit tool is designed for collecting data on patients aged ≥75 years, who experienced a short-stay (≤ 2 days) admission to the Royal Hobart Hospital (RHH) with Congestive Cardiac Failure (CCF) in 2010-11 or 2015-16.

The audit will be used retrospectively to extract data from the medical records of patients who experienced a short-stay admission at the RHH for CCF in the time frame specified. Data will be collected concerning the management of patients' condition both during the hospital admission and outside of the hospital setting. Data concerning the patients' self-management and attempts at accessing other forms of healthcare prior to hospital admission will also be collected.

The questions asked pertain to the demographical, social and clinical aspects of the patient, with a focus on severity of condition and access to care outside of the hospital setting.

The audit tool is divided into two sections; the first section contains information regarding patient demographics and admission details. This data is likely to be found within the patient history files and progress notes.

The second section is related to the management and care of the patient whilst in the RHH. This data is likely to be found within the medication charts and other documentation related to the patient's admission diagnosis and prescribed treatment regimen.

The anticipated time to complete the audit is around 10 minutes for every patient, depending on the complexity and accessibility of patient history and documentation.

Please correctly fill in details regarding the researcher ID, data collection ID, and the patient ID on the separate 'Research ID Reference Sheet' form and ensure that this form is stored separately from the audit tool to ensure that patient confidentiality requirements are met.

Section A: This section contains demographical and general information about the patient. Most of the information can be found in either the admission details form or the patient history folder.

Date:

Reference number:

1) Gender:

☐ Male

☐ Female

2) Patient Age:

3) Postcode:

4) a. Date of admission to RHH:

b. Date of Discharge from RHH:

c. Length of hospital stay: **days**

5) Type of admission:

☐ Emergency ☐ Elective

☐ Palliative ☐ Statistical

☐ Other

6) Discharge Destination:

☐ Home ☐ Not Available

☐ Other Ward ☐ Other (please specify)

☐ Deceased ☐ Other healthcare facility

7) Mode of arrival:

☐ Ambulance

☐ Private transport

☐ Other (please specify)

8) Type of patient:

☐ Public ☐ DVA

☐ Private ☐ Not available

9) Marital Status:

☐ Married ☐ Other

☐ Divorced

☐ Single

☐ De facto

☐ Widowed

☐ Separated but not divorced

10) Living Status :

☐ Alone

☐ Spouse

☐ Other family member (please specify)

☐ RACF

☐ Other

☐ Not available

11) Emergency department presentations in the previous 12 months?

☐ No (next question)

☐ Yes **Number:** **Admitted:** ☐ Yes ☐ No

Reason for ED presentation/s:

12) Hospital admissions in the previous 12 months

☐ No (next question) ☐ Yes **Number:**

Reason for previous admission/s:

Was a NYHA index calculated? If yes score (for each admission):

Was a LVEF calculated? If yes % (for each admission):

Section B: This section contains information regarding the management of patients' care during **this admission** at the RHH. Details can be found within the observation charts, medication charts, and patient history.

13) Reason for admission (as per admitting doctors notes. e.g. pulmonary oedema secondary to CCF):

14) History of presenting complaint, including attempts to access other types of healthcare (e.g. GP)

15) Comorbidities. Please tick all that apply:

☐ Myocardial Infarction	☐ Congestive Cardiac Failure	☐ Malignancy
☐ Cerebrovascular Disease	☐ Diabetes complications	☐ Peripheral vascular disease
☐ Chronic pulmonary disease	☐ Renal disease	☐ Rheumatologic disease
☐ Dementia	☐ Peptic ulcer	☐ Moderate/severe liver diseas
☐ Diabetes	☐ Hemi/paraplegia	☐ Mild liver disease
☐ Metastatic solid tumour	☐ AIDS/HIV	

16) Medications on admission:

Drug name	Dose	Frequency

16) Medications on discharge:

Drug name	Dose	Frequency

17) Charlson comorbidity score for this admission (if calculated):

18) NYHA index for this admission (if calculated):

19) LVEF for this admission (if calculated):

15) Attendance at a cardiac outpatients clinic:

☐ No Why

☐ Yes How frequently Last attended (date)

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HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

UTAS

19 September 2017

Professor Leigh Kinsman
C/- Royal Hobart Hospital

Sent via email

Dear Professor Kinsman

REF NO: H0016698
TITLE: Factors contributing to the increase in in Emergency Department (ED) presentations and subsequent short-stay hospital admissions to the Royal Hobart Hospital (RHH) by those aged 75 years and older with Congestive Cardiac Failure (CCF)

Document	***Version***	***Date***
Low Risk Application		
Privacy Form		
Audit Tool CCF	Version 2	
Finance and Administration form		

The Tasmanian Health and Medical Human Research Ethics Committee considered and approved the above documentation on **13 September 2017** to be conducted at the following site(s):

Royal Hobart Hospital

Please ensure that all investigators involved with this project have cited the approved versions of the documents listed within this letter and use only these versions in conducting this research project.

This approval constitutes ethical clearance by the Health and Medical HREC. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approvals of other bodies or authorities are required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

All committees operating under the Human Research Ethics Committee (Tasmania) Network are registered and required to comply with the *National Statement on the Ethical Conduct in Human Research* (NHMRC 2007 updated 2014).

Therefore, the Chief Investigator's responsibility is to ensure that:

(1) The individual researcher's protocol complies with the HREC approved protocol.

(2) Modifications to the protocol do not proceed until **approval** is obtained in writing from the HREC. Please note that all requests for changes to approved documents must include a version number and date when submitted for review by the HREC.

(3) Section 5.5.3 of the National Statement states:

Researchers have a significant responsibility in monitoring approved research as they are in the best position to observe any adverse events or unexpected outcomes. They should report such events or outcomes promptly to the relevant institution/s and ethical review body/ies and take prompt steps to deal with any unexpected risks.

The appropriate forms for reporting such events in relation to clinical and non-clinical trials and innovations can be located at the website below. All adverse events must be reported regardless of whether or not the event, in your opinion, is a direct effect of the therapeutic goods being tested. http://www.utas.edu.au/research-admin/research-integrity-and-ethics-unit-rieu/human-ethics/human-research-ethics-review-process/health-and-medical-hrec/managing-your-approved-project

(4) All research participants must be provided with the current Patient Information Sheet and Consent Form, unless otherwise approved by the Committee.

(5) The Committee is notified if any investigators are added to, or cease involvement with, the project.

(6) This study has approval for four years contingent upon annual review. A *Progress Report* is to be provided on the anniversary date of your approval. Your first report is due 13 September 2018**.** You will be sent a courtesy reminder closer to this due date.

(7) A *Final Report* and a copy of the published material, either in full or abstract, must be provided at the end of the project.

Should you have any queries please do not hesitate to contact me on (03) 6226 2764.

Yours sincerely

Jude Vienna-Hallam
Ethics Administration Officer

Exploring views of patients to better understand the role of perceived access to care in potentially preventable hospital admissions

INTRODUCTION AND CONSENT TO CONTACT

Invitation

You are invited to participate in a research study to explore the journey leading to short-stay hospital admissions of patients' with chronic conditions in the South of Tasmania.

The study is being conducted by:

- Claire Morley, PhD Candidate, School of Health Sciences, University of Tasmania
- Sue Sanderson, Nurse Practitioner, Chronic Cardiac Care, Royal Hobart Hospital
- Dr. Jim Stankovich, Research Fellow, Health Services Innovation, Tasmania
- Professor Gregory Peterson, Co-director Health Services Innovation, Tasmania
- Professor Leigh Kinsman, Professor of Healthcare Improvement, Joint appointment: University of Tasmania and Tasmanian Health Service, North.

1. 'What is the purpose of this study?'

The purpose of this study is to explore the journey leading to short-stay hospital admissions of patients' with chronic conditions in the South of Tasmania.

2. 'Why have I been invited to participate in this study?'

You may be eligible to participate in this study because you are an inpatient at the Royal Hobart Hospital with a chronic condition.

3. 'What does this study involve?'

If you agree to take part in this study, we will ask you to take part in an interview, in your home (or somewhere you would like to meet). The interview will involve questions relating to your experience immediately prior to and during your current hospital admission.

4. 'What do I do now?'

If you would like to be involved in the study, please sign the consent below allowing your contact details to be passed on to a member of the research team. Once you have been discharged from the hospital a member of the research team will contact you to give further details about the project and arrange a time and venue for an interview.

Thank you for considering this study

Professor Leigh Kinsman
Chief Investigator

Consent Form

I, _____ consent to Sue Sanderson passing on my contact details (landline, mobile phone number and residential address) to Claire Morley. I consent for Claire to contact me to discuss the project further and, if I still wish to be involved, arrange a time for an interview.

Signed: _____

Name: _____

Date: _____/_____/_____

The following section regarding the witness is not essential but may be appropriate for patients where the research team feels that the participant should have a witness to the consent.

Signed: _____

Name: _____

Date: _____/_____/_____

Exploring views of patients to better understand the role of perceived access to care in potentially preventable hospital admissions

PARTICIPANT INFORMATION SHEET

Invitation

You are invited to participate in a research study to explore the patient journey leading to short-stay hospital admissions of patients' with chronic conditions in the South of Tasmania.

The study is being conducted by:

- Claire Morley, PhD Candidate, School of Health Sciences, University of Tasmania
- Sue Sanderson, Nurse Practitioner, Chronic Cardiac Care, Royal Hobart Hospital
- Dr. Jim Stankovich, Research Fellow, Health Services Innovation, Tasmania
- Professor Gregory Peterson, Co-director Health Services Innovation, Tasmania
- Professor Leigh Kinsman, Professor of Healthcare Improvement, Joint appointment: University of Tasmania and Tasmanian Health Service, North.

Before you decide whether or not you wish to participate in this study, it is important for you to understand why the research is being done and what it will involve. Please take the time to read the following information carefully and discuss it with others if you wish.

1. 'What is the purpose of this study?'

The purpose of this study is to explore the journey leading to short-stay hospital admissions of patients' with chronic conditions in the South of Tasmania.

2. 'Why have I been invited to participate in this study?'

You are eligible to participate in this study because you have recently experienced a short-stay hospital admission for a chronic condition at the Royal Hobart Hospital (RHH).

3. 'What if I don't want to take part in this study, or if I want to withdraw later?'

Participation in this study is voluntary. It is completely up to you whether or not you participate. If you decide not to participate, or to withdraw from the study, it will not affect your relationship with the clinicians involved in the management of your healthcare. If you choose to withdraw from the study during the interview, please inform the interviewer who will stop the interview and destroy any recording. If you should choose to withdraw from the study after the interview, please contact the researcher, Claire Morley (0427 ******) who will destroy both the recording and transcript of your interview.

4. 'What does this study involve?'

We will ask you to take part in an interview, in your home (or somewhere you would like to meet), to talk about the journey that ultimately led to your recent admission to the RHH. The interview will be audio-recorded and transcribed to enable the researcher to recheck facts later. A copy of the transcript can be posted to you if you request this. You can have your family or carer with you at the interview if you would like. We think the interview will take approximately 1 hour depending on what you would like to talk about.

5. 'How is this study being paid for?'

There is no dedicated funding for this research. The PhD candidate, Claire Morley is in receipt of an Australian Postgraduate Award scholarship to enable her to complete her studies.

6. 'Are there risks to me in taking part in this study?'

There are no physical risks associated with the study. The study will ask questions about your recent hospital admission and the process leading up to this admission. You may refuse to answer any of the questions and you may take a break at any time during the study.

7. 'Will I benefit from the study?'

There are no direct benefits to you for being part of this study. It is hoped that the results of this study may lead to improvements in the management of chronic conditions in the community and thereby reduce the need for hospital admissions.

8. 'Will taking part in this study cost me anything, and will I be paid?

Participation in this study will not cost you anything. Your participation in the research is entirely voluntary.

9. 'How will my confidentiality be protected?'

Although the research team has access to your personal details (name, address, date of birth), any identifying information will be removed before any reporting or publication of data. Your interview transcript will be coded with a unique identification number. The key to the code linking you to the transcript will be stored electronically, separate from your transcript and recording. Data will be held securely on a password protected computer at a UTAS office, and only accessible to the research team. Hard copies of interview transcripts will be kept in a locked filing cabinet in the locked office of the researcher, Claire Morley.

10. 'What happens with the results?'

The results will form part of the PhD candidate's final thesis. Results of the study may also be published in peer-reviewed journals or presented at academic conferences. In any publication, information will be provided in such a way that you cannot be identified.

11. 'What should I do if I want to discuss this study further before I decide?'

When you have read this information, you will be provided an opportunity to ask questions and any queries you may have can be answered. If you would like to know more at any stage, please do not hesitate to contact Claire Morley on 0427 ******.

12. 'Who should I contact if I have concerns about the conduct of this study?'

This study has been approved by the Tasmanian Health and Medical Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study you should contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 7479 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. You will need to quote H0016699.

Thank you for taking the time to consider this study.

This information sheet is for you to keep.

CONSENT FORM

Exploring views of patients to better understand the role of perceived access to care in potentially preventable hospital admissions

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1. I acknowledge that the nature, purpose and contemplated effects of the project so far as it affects me, have been fully explained to my satisfaction by the research worker and my consent is given voluntarily.

2. The details of the project have also been explained to me, including the anticipated length of time it will take. I understand that my involvement means participation in an interview to discuss my experience of a short-stay hospital admission at the Royal Hobart Hospital (RHH) for Congestive Cardiac Failure (CCF), which will take approximately 1 hour. This interview will take place at a venue and time convenient to me.

3. I understand that here are no associated risks with participation in this project. There will be a minor inconvenience due to the amount of time taken to participate in the interview process. I am able to withdraw from the interview and the project at any stage without any effect on my future medical care.

4. Although I understand that the purpose of this research project is to explore the journey leading to a short-stay hospital admission of patients' with chronic conditions, it has also been explained that my involvement may not be of any benefit to me.

5. I have been given the opportunity to have a member of my family or friend present while the project was explained to me.

6. I am informed that no information regarding any medical history will be divulged and the results of any tests involving me will not be published so as to reveal my identity.

7. I understand that my involvement in the project will not affect my relationship with the clinicians involved in the management of my healthcare needs. I also understand that I am free to withdraw from the project at any stage. My withdrawal will not effect my legal rights, my medical care or my relationship with the hospital or my doctors.

8. I understand that I will be given a signed copy of this patient information sheet and consent form. I am not giving up my legal rights by signing this consent form.

9. I understand that the research will be conducted in accordance with the latest versions of the *National Statement on Ethical Conduct in Human Research* and applicable privacy laws

Name of participant _____

Signature of participant _____ Date _____

The following section regarding the witness is not essential but may be appropriate for patients where the research teams feel that the participant should have a witness to the consent.

Name of witness (if appropriate) _____

Signature of witness _____Date _____

I have explained this project and the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation.

Name of investigator _____

Signature of investigator _____ Date _____

Indicative Semi-Structure for Qualitative Interviews with Patients and their Families.

1. Can you tell me about your recent hospital admission?
2. Do you think of anything that could have been done differently to avoid this admission to hospital?
3. Have you experienced similar symptoms in the past?
4. How did you manage this?
5. What do you understand about your condition (CCF)?
6. How do you normally 'manage' your condition?
7. When did you first realise you needed to see a doctor?
8. Do you have a 'usual' GP or surgery?
9. Did you try to contact your GP? If yes, what was the outcome?
10. How easy/difficult is it normally to get an appointment with your GP?
11. How easy/difficult is it normally to get an appointment with your GP at a time that suits you?
12. Does your GP bulk bill?
13. Have you ever delayed seeing your GP due to cost?
14. How far away do you need to travel to see your GP?
15. How do you normally travel to your GP?
16. How would you describe your relationship with your GP?
17. How compliant are you with your medication regime?
18. Do you have a heart failure management plan?

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HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

UTAS

26 September 2017

Professor Leigh Kinsman
C/- Royal Hobart Hospital

Sent via email

Dear Professor Kinsman

REF NO: H0016699
TITLE: Exploring views of patients to better understand the role of perceived access to care in potentially preventable hospital admissions

Document	***Version***	***Date***
Low risk application	Version 2	
Consent to the interview		
Finance and Administration form		
Introductory letter with a consent to be contacted after discharge from hospital		
Participant Information Sheet	Version 2	
Proposed list of questions for semi-structured interviews	Version 2	

The Tasmanian Health and Medical Human Research Ethics Committee considered and approved the above documentation on **25 September 2017** to be conducted at the following site(s):

Royal Hobart Hospital

Please ensure that all investigators involved with this project have cited the approved versions of the documents listed within this letter and use only these versions in conducting this research project.

This approval constitutes ethical clearance by the Health and Medical HREC. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approvals of other bodies or authorities are required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

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Therefore, the Chief Investigator's responsibility is to ensure that:

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(3) Section 5.5.3 of the National Statement states:

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The appropriate forms for reporting such events in relation to clinical and non-clinical trials and innovations can be located at the website below. All adverse events must be reported regardless of whether or not the event, in your opinion, is a direct effect of the therapeutic goods being tested. http://www.utas.edu.au/research-admin/research-integrity-and-ethics-unit-rieu/human-ethics/human-research-ethics-review-process/health-and-medical-hrec/managing-your-approved-project

(4) All research participants must be provided with the current Patient Information Sheet and Consent Form, unless otherwise approved by the Committee.

(5) The Committee is notified if any investigators are added to, or cease involvement with, the project.

(6) This study has approval for four years contingent upon annual review. A *Progress Report* is to be provided on the anniversary date of your approval. Your first report is due 25 September 2017**.** You will be sent a courtesy reminder closer to this due date.

(7) A *Final Report* and a copy of the published material, either in full or abstract, must be provided at the end of the project.

Should you have any queries please do not hesitate to contact me on (03) 6226 2764.

Yours sincerely

Jude Vienna-Hallam
Ethics Administration Officer